# Hypertensive disorders in pregnancy: 2019 National guideline

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On behalf of the Ministerial National Committee on Confidential Enquiries into Maternal Deaths in South Africa.

**Background.** Hypertensive disorders of pregnancy (HDP), including pre-eclampsia/eclampsia, account for significant maternal and fetal mortality globally and especially in South Africa.
**Objective.** To formulate clinical guidelines for the management of HDP in order to substantially reduce the number of maternal deaths from HDP.
**Methods.** The Appraisal of Guidelines for Research and Evaluation (AGREE II) instrument was used to formulate the guidelines and included six domains: scope and purpose; stakeholder involvement; rigour and development; clarity of presentation; applicability; and editorial independence.
**Recommendations.** The guideline stipulates management strategies for all levels of care where women with hypertensive disorders in pregnancy are seen. It also has a detailed implementation plan.
**Conclusion.** A clinical guideline that is of practical value has been formulated by a wide group of stakeholders. It is hoped that its dissemination and implementation by all doctors and nurses will reduce mortality and morbidity associated with HDP.

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# 1. Introduction

Hypertensive disorders of pregnancy (HDP) are the most common direct cause of maternal mortality and account for 18% of all maternal deaths in South Africa (SA).[1,2] Deaths from HDP occur in all categories of hypertensive disorders, with eclampsia and pre-eclampsia being the most common final causes of death. The main causes leading to death are cerebral haemorrhage and pulmonary oedema and, therefore, focus should be placed on the immediate lowering of acute severe hypertension and avoidance of fluid loading. These steps will reduce the percentage of preventable deaths, which was ~70% during the 2014 - 2016 period.[2] Unfortunately, no progress has been made in reducing deaths due to HDP during the last decade (Fig. 1).

Table 1 illustrates that almost 78.5% ($n$=153) of maternal deaths due to HDP occurred at levels which are supposed to have specialist care, while Fig. 2 hows the high institutional maternal mortality ratio (iMMR) due to HDP in regional, tertiary and national central hospitals.

Nearly 75% of maternal deaths due to HDP were thought to be potentially preventable (Fig. 3) and this percentage has increased over the last few years. HDP is now the second biggest contributor to potentially preventable deaths (Fig. 4).

Fig. 5 illustrates how HDP has increased in importance as the cause of potentially preventable deaths, while management of the two other major conditions – non-pregnancy-related infections (NPRI) and obstetric haemorrhage (OH) – has improved.

Fig. 6 shows that the proportion of potentially preventable deaths increased, contrary to all other underlying causes. During this time, the overall iMMR dropped from 190/100 000 live births in 2009 to 135/100 000 live births in 2017.

The Maternal Morbidity and Mortality Audit System (MaMMAS) allows for evaluation of the quality of care received by a woman at each level of care prior to her death. Fig. 7 illustrates the avoidable factors per level of care. There were proportions of 50% and 65% of the avoidable factors at each level of care.

Fig. 8 details what the healthcare professional-avoidable factors were. The numbers in brackets next to each level of care indicate the number of women who subsequently died due to HDP where care for at least part of the time occurred before her death. The major problems were lack of proper assessment and making a diagnosis at the primary level of care, while not adhering to standard protocols was the biggest problems at regional, tertiary and national central hospitals.

Fig. 9 shows the distribution of avoidable factors in the management of HDP per level of care for healthcare professionals. At the primary level of care, assessment and diagnosis were again the main problems, while not adhering to standard protocols was the biggest problem at the hospitals where a specialist should be present.

The data in Figs 7 - 9 clearly show that management of HDP is a problem at all levels of care and, for this reason, the HDP guidelines were reviewed and re-written according to the AGREE II format to ensure that they are comprehensive, deal with all levels of care and specifically concentrate on the problems identified at the different levels of care.[3]

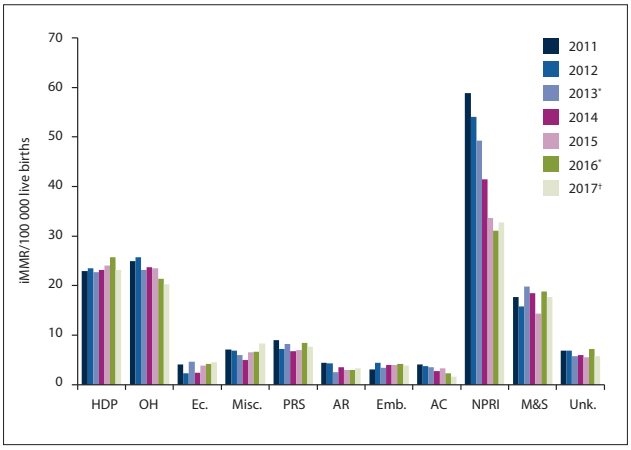


*Fig. 1. iMMR per underlying cause: 2011 - 2017. (iMMR = institutional maternal mortality ratio; HDP = hypertensive disorders in pregnancy; OH = obstetric haemorrhage; Ec. = ectopic pregnancy; Misc. = miscarriage; PRS = pregnancy-related sepsis; AR = anaesthetic-related; Emb. = embolism; AC = acute collapse causes unknown; NPRI = non-pregnancy-related infections; M&S = pre-existing medical and surgical disorders; Unk. = unknown.)*

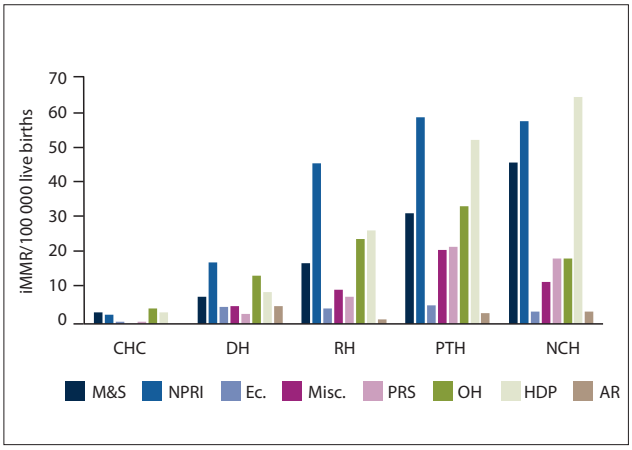


*Fig. 2. iMMR per level of care and underlying causes: 2017. (CHC = community healthcare centre; DH = district hospital; RH = regional hospital; PTH = provincial tertiary hospital; NCH = national central hospital; M&S = pre-existing medical and surgical disorders; NPRI = non-pregnancy-related infections; Ec. = ectopic pregnancy; Misc. = miscarriage; PRS = pregnancy-related sepsis; OH = obstetric haemorrhage; HDP = hypertensive disorders in pregnancy; AR = anaesthetic-related.)*

**Table 1. Distribution and number of maternal deaths per level of care, 2017***

| Primary obstetric problem | CHC | DH | RH | TH | NCH | PH | Total |
|---|---|---|---|---|---|---|---|
| Medical and surgical disorders | 5 | 29 | 42 | 30 | 27 | 10 | 143 |
| NPRI | 4 | 66 | 112 | 56 | 34 | 4 | 276 |
| Ectopic pregnancy | 1 | 18 | 11 | 5 | 2 | 0 | 37 |
| Miscarriage | 0 | 19 | 24 | 20 | 7 | 0 | 70 |
| PRS | 1 | 11 | 19 | 21 | 11 | 1 | 64 |
| OH | 7 | 52 | 59 | 32 | 11 | 9 | 170 |
| HDP | 5 | 34 | 65 | 50 | 38 | 3 | 195 |
| Anaesthetic complications | 0 | 19 | 3 | 3 | 2 | 2 | 29 |
| Adverse drug reactions | 0 | 1 | 1 | 5 | 3 | 0 | 10 |
| Embolism | 3 | 7 | 9 | 8 | 1 | 3 | 31 |
| Acute collapse - unknown cause | 2 | 7 | 2 | 1 | 0 | 0 | 12 |
| Miscellaneous | 0 | 0 | 2 | 2 | 1 | 0 | 5 |
| Unknown | 3 | 5 | 6 | 0 | 0 | 3 | 17 |
| Maternal deaths | 31 | 268 | 355 | 233 | 137 | 35 | 1 059 |

CHC = community healthcare centre; NCH = national central hospital; NPRI = non-pregnancy-related infections; PRS = pregnancy-related sepsis; OH = obstetric haemorrhage; HDP = hypertensive disorders of pregnancy.
*Excludes deaths outside facilities and coincidental deaths.

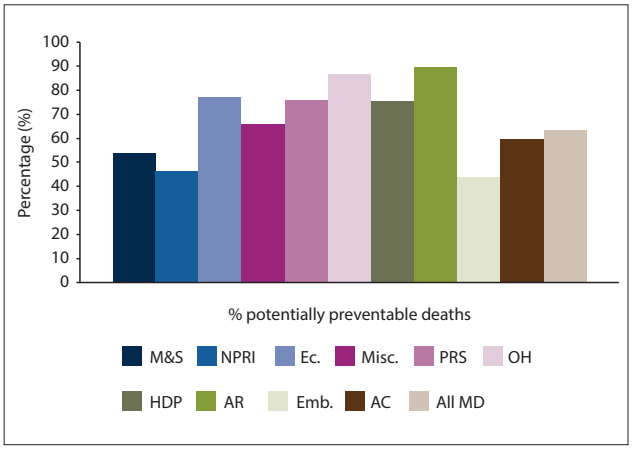


*Fig. 3. Proportion of potentially preventable deaths per disease category. (M&S = pre-existing medical and surgical disorders; NPRI = non-pregnancy-related infections; Ec. = ectopic pregnancy; Misc. = miscarriage; PRS = pregnancy-related sepsis; OH = obstetric haemorrhage; HDP = hypertensive disorders in pregnancy; AR = anaesthetic-related; Emb. = embolism; AC = acute collapse; MD = maternal deaths.)*

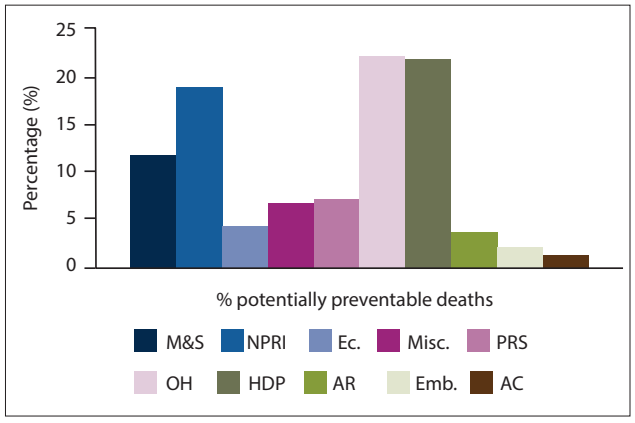


*Fig. 4. Contribution of underlying causes to potentially preventable deaths. (M&S = pre-existing medical and surgical disorders; NPRI = non-pregnancy-related infections; Ec. = ectopic pregnancy; Misc. = miscarriage; PRS = pregnancy-related sepsis; OH = obstetric haemorrhage; HDP = hypertensive disorders in pregnancy; AR = anaesthetic-related; Emb. = embolism; AC = acute collapse.)*

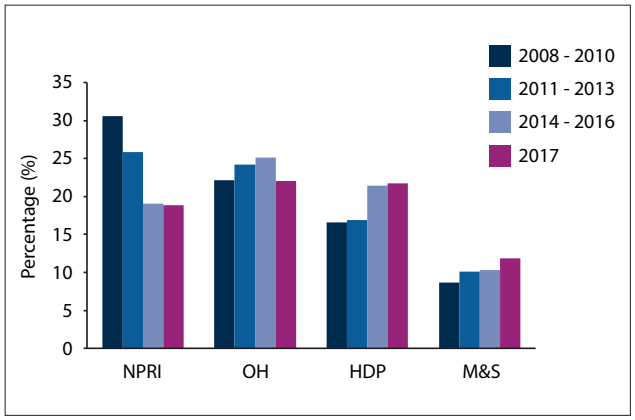


*Fig. 5. Distribution of potentially preventable deaths: 2008 - 2017. (NPRI = non-pregnancy-related infections; OH = obstetric haemorrhage; HDP = hypertensive disorders in pregnancy; M&S = pre-existing medical and surgical disorders.)*

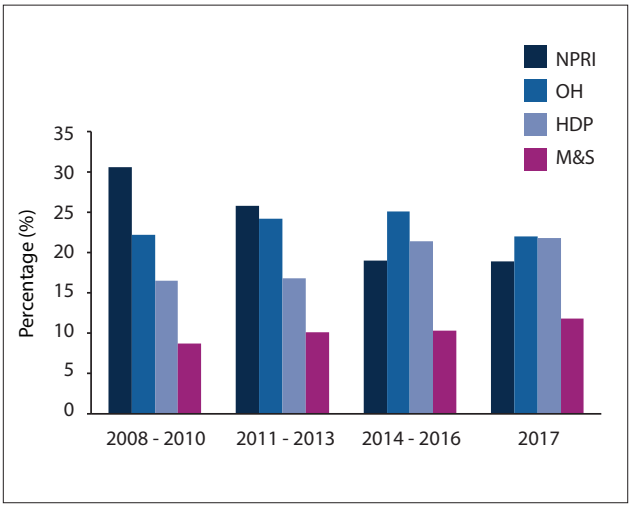


*Fig. 6. Distribution of potentially preventable deaths: 2008 - 2017. (NPRI = non-pregnancy-related infections; OH = obstetric haemorrhage; HDP = hypertensive disorders in pregnancy; M&S = pre-existing medical and surgical disorders.)*

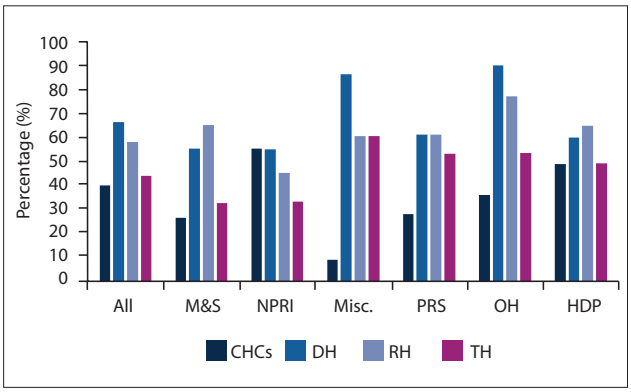


*Fig. 7. Proportion of avoidable factors per level of care for common conditions. (M&S = pre-existing medical and surgical disorders; NPRI = non-pregnancy-related infections; Misc. = miscarriage; PRS = pregnancy-related sepsis; OH = obstetric haemorrhage; HDP = hypertensive disorders in pregnancy, CHC = community health centre; DH = district hospital; RH = regional hospital; TH = tertiary hospital.)*

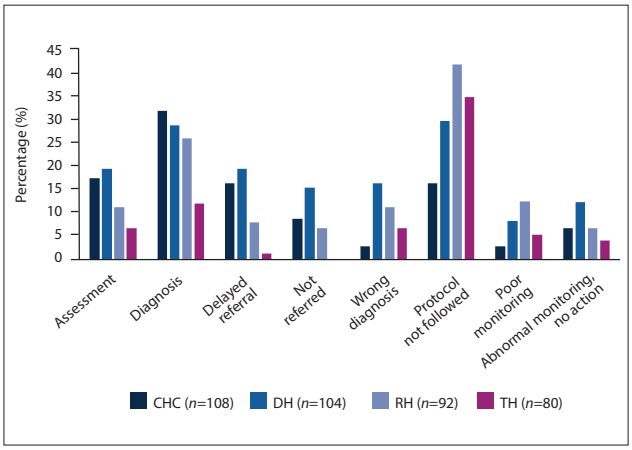


*Fig. 8. Distribution of avoidable factors per level of care for all assessable hypertensive cases. (CHC = community healthcare centre; DH = district hospital; RH = regional hospital; TH = tertiary hospital.)*

**Table 2. Definitions of key terms**

| Term | Definition |
|---|---|
| Chronic hypertension | Hypertension pre-dating pregnancy or diagnosed before 20 weeks' GA |
| White-coat hypertension | Elevated office BP levels ≥140/90 mmHg but normal BP measurements at home |
| Gestational hypertension | New-onset hypertension after the 20th week of pregnancy |
| Pre-eclampsia | BP ≥140/90 mmHg accompanied by proteinuria* or evidence of organ dysfunction after the 20th week of pregnancy |
| HELLP syndrome | Characterised by haemolysis, elevated liver enzymes and low platelet counts |

GA = gestational age; BP = blood pressure.
*Proteinuria is therefore not mandatory for the diagnosis of pre-eclampsia.

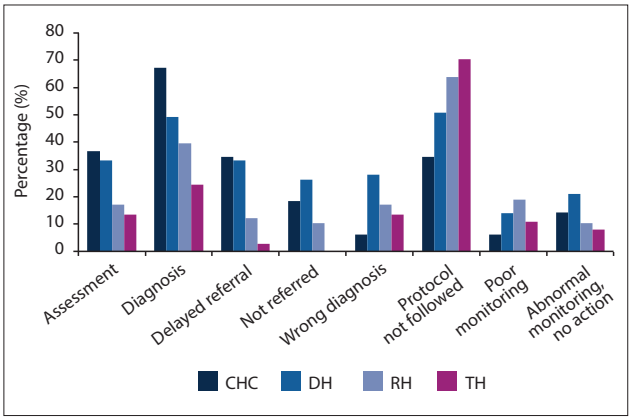


*Fig. 9. Distribution of avoidable factors in the management of HDP per level of care for healthcare professionals. (CHC = community healthcare centre; DH = district hospital; RH = regional hospital; TH = tertiary hospital.)*

## 2. Scope and purpose of new management guidelines for HDP

The overall objective is to improve the management of women with HDP and thereby reduce morbidity and mortality rates.

The health question covered specifically is pregnant women with HDP and its variants at all levels of care. The target population is pregnant women with hypertension at every level of care.

## 3. Methods

### 3.1 Stakeholder involvement

The guidelines were developed by individuals from the following organisations: the National Department of Health (NDoH); the Colleges of Obstetrics and Gynaecology, Anaesthesiology and Family Medicine; the Society of Obstetrics and Gynaecology; the Anaesthetic Society of South Africa; the Academy of Family Practice; the Departments of Obstetrics and Gynaecology from the medical schools; the Society of Midwives in South Africa; the Priorities in Perinatal Care Association; and the Rural Doctors Association of South Africa.

Target users are healthcare professionals at primary healthcare clinics, as well as district, regional and tertiary hospitals dealing with pregnant women.

### 3.2 Rigour of development

The recommendations in this guideline are based on available literature and expert opinion. Unfortunately, there is a lack of good-quality randomised controlled trials in the field of hypertension in pregnancy. The International Society for the Study of Hypertension in Pregnancy (ISSHP) guideline of 2018 was used as a template for this guideline.[4] The SA NDoH maternal mortality data (Saving Mothers Report)[2] on deaths due to HDP were used to identify problem areas in clinical management. A guideline strategy meeting was held in Johannesburg in June 2018. Experts from all obstetrics and gynaecology academic centres in SA were invited to participate. Each expert was tasked with answering key questions relevant to the objectives within their area of expertise. They were advised to conduct literature searches but this was not methodically defined. The proposed content of the guideline was interrogated and debated by those present. The discussions were based on evidence and clinical experience of the expert group. If evidence was lacking, a consensus was adopted among participants. Consensus was obtained by doing a series of round-robin e-mails with different iterations until unanimity was obtained.

### 3.3 Editorial independence

Funding for the development of the guidelines was obtained from the Discovery Foundation, South African Society of Obstetricians and Gynaecologists (SASOG), and the South African Medical Research Council (SAMRC). The organisations were not involved in discussions or development of the guideline. Any competing interests of guideline development group members were recorded and addressed at each meeting.

## 4. General issues

1. International Society for the Study of Hypertension in Pregnancy (ISSHP) classification will be used[4] and the key terms used throughout the guideline are defined in Table 2.

2. Standard protocol for measuring blood pressure

- Use machines validated for use in pregnancy and ensure the provision of sufficient functional BP machines.
- The machine used in SA clinical trials is recommended, i.e. the CRADLE Vital Signs Alert which has a traffic light algorithm and is robust and cheap.[5] A national tender to purchase these BP machines should be considered.
- Machines should be regularly calibrated and the results should be monitored by the medical managers.
- The BP machines must be robust.
- The purchasing committee must have specifications of machines. (Guideline on how calibration should be done. Validation in pregnancy must be in specifications.)
- Blood pressure levels to be measured in the sitting position with legs uncrossed and in relaxed position. The arms should be free of clothing, and arm supported at the level of the heart.
- If the mean upper-arm circumference (MUAC) is >33 cm, a larger cuff size should be used. Current machines are available with 2 sizes for adults – adult and obese.[4]
- The BP should be repeated within 15 minutes if there are slight elevations in BP or when BPs between 140 and 150 mmHg systolic pressure are recorded.

- Level of BP agreed ≥140 mm systolic and/or ≥90 mm agreed as definition of hypertension.[4]

3. Borderline blood pressure levels in low-risk pregnant women (135/85 - 139/89 mmHg; pre-hypertension)
- BP repeated within 30 minutes - 2 hours and, if still borderline, asked to return within 3 - 7 days.
- If the blood pressure is normal on repeat measurement, the woman can be followed up as a low-risk patient).

4. Biochemical angiogenic tests (soluble fms-like tyrosine kinase 1 (sFlt-1) to placental growth factor (PlGF)( sFlt-1/PlGF)) ratio or the PlGF on its own cannot be recommended for implementation at the present time.[4]

5. Calcium supplementation should be given to all pregnant women.
- 500 mg elemental calcium daily, with a 2-hour gap between iron and calcium intake.
- Start at any gestation, but as early as possible.[6]
- Motivation: The WHO recommendation of 1.5 g elemental calcium (high-dose) daily is based on one systematic review. A repeat review done on low-dose calcium showed similar results to high-dose trials. In SA studies, women are very calcium-deficient and giving 500 mg/day of elemental calcium is a reasonable dosage, as it is cost-effective, easier to swallow and SA data suggest that 500 mg of elemental calcium per day has the same effect as 1.5 g elemental calcium. Calcium reduces blood pressure in women with hypertension, and therefore it should not be restricted to women for prevention of hypertension. It can be started at any gestation and, ideally, at the first antenatal visit. No harm of prescribing calcium has been described to date. In one study,[6] there were more women with HELLP in the calcium group in trials but significantly less serious outcomes in the calcium group.

6. Visual dipsticks should be used to test for proteinuria in a clean catch specimen of urine and that infection as a cause of the proteinuria be ruled out by absence of WBCs and nitrites in a repeat clean catch specimen. This should be done at all antenatal visits.[7-9]

7. Protein/creatinine ratio or 24-hour urine protein can be used as a test for assessing the amount of protein.[7-9]

8. The ISSHP high-risk factors list be used during history taking for identifying patients at risk at all levels of healthcare and aspirin should be started for those at risk if the woman books early enough to start aspirin (ideally 12 - 14 weeks) but can be up to 20 weeks' gestation (with 75 - 162 mg/day aspirin – a quarter or half an aspirin tablet).[4,10-12]
- Prior pre-eclampsia
- Chronic hypertension
- Multiple gestation
- Pre-gestational diabetes
- Maternal BMI >33
- Anti-phospholipid syndrome/systemic lupus erythematosus (SLE)
- Assisted reproduction therapies.

These risk factors should be on the basic antenatal care (BANC) plus qualifying first visit tick sheet, in the national guidelines for maternity care in SA and in the Maternity Case Record (MCR).[13]

9. Need for clear, straightforward actions that primary healthcare nurses can follow for the first visit.
- History taking at primary healthcare clinics (PHCs) is done by general nurses who are not experienced in maternity care, therefore history taking instructions need to be clear and should include tick lists.
- It is also important that obesity/BMI is measured. This can be done by BMI or MUAC. A BMI of 33 and an MUAC of 35 are critical measures.[14]

10. Mobile clinics
- Mobile clinics are currently employed to reach women who have no means of transport. Some mobile clinics go out every 6 weeks.
- Some women will require antenatal care every 2 weeks, particularly in the third trimester.
- Mobile clinics feasible for low-risk patients up to 34 weeks.
- If risk factor identified, patient should be referred.
- Mobile clinics to follow same guidelines as for PHC.

## 5. Concept of next level of expertise

Facilities differ in terms of resources and geography throughout the country. For this reason, referral from the PHCs, community healthcare centres (CHCs) or, in some circumstances, district hospitals (DHs) must be to what is termed the next level of expertise. At the next level of expertise, the woman must be seen by an advanced midwife (with special training) or a doctor dealing with pregnant women, and there have to be facilities to perform haemoglobin (Hb), platelets, urea, creatinine, alanine aminotransferase (ALT) and urine culture tests, as well as a sonar examination. Blood results must be available within a reasonable time so that management can be planned. The next level of expertise must have a rapid and simple means of communication to specialists. Each catchment area will need to decide where the next level of expertise from PHCs or CHCs is. High-risk antenatal clinics can be created at CHCs and should be present in all DHs.

## 6. Concept of catchment area

All areas in SA have defined referral routes to specialist care services. These referral routes do not always follow the district boundaries and so they are called catchment areas. Each catchment area should have a regional or tertiary hospital that it refers to. The main hospital (regional or tertiary) in the catchment area must be involved when developing these guidelines into protocols for a hospital or clinic. Local solutions have to be developed, e.g. developing high-risk obstetric clinics at CHCs and bypassing DHs when dealing with severely ill pregnant women to speed up transfer to the main hospital in the catchment area. District clinical specialists of the area should be involved in facilitating these discussions and in finalising the protocols.

## 7. Guideline for managing HDP per level of care

### 7.1 Primary healthcare level: Initial assessment and management

*Includes PHCs (e.g. 8 am - 5 pm clinic and clinics where planned births are not conducted), mobile clinics, CHCs/Midwife Obstetric Unit (MOU)/24-hour clinic where planned births are performed.*

#### 7.1.1 Women with pre-hypertension (BP 130 - 139/85 - 89 mmHg)
- Repeat blood pressure after rest (30 minutes - 2 hours); if still pre-hypertension, review in 3 - 7 days at PHC; if normal, follow up as low-risk patient.[15]

**7.1.2 Hypertension with no risk factors, no proteinuria and no symptoms**

- Start alpha-methyldopa (500 mg 8-hourly) and send to next level of expertise within 3 days.[16]
- Haemoglobin (Hb), platelets, and creatinine tests, as well as a sonar for fetal evaluation, need to be done.

**7.1.3 HDP with risk factors (listed in point 8 above) but no proteinuria**

- Refer to DH.
- Start low-dose aspirin.
- Hb, platelets, creatinine, and a sonar for fetal evaluation need to be done.

**7.1.4 Women with hypertension <32 weeks' GA**

- Refer to a DH for investigation for pre-eclampsia.

**7.1.5 Hypertension with proteinuria (≥1+), no severe features**

- Same-day referral to nearest hospital accredited for caesarean delivery.
- Inform receiving hospital.
- GA ≥20 weeks. (If earlier GA, case to be discussed with receiving hospital regarding same-day or next-day referral.)
- Give magnesium sulphate if receiving doctor suggests it.

**7.1.6 Pre-eclampsia with severe features (headache, chest/epigastric pain/discomfort/visual disturbances/eclampsia) or BP ≥160/110 mmHg**[17]

- Stabilise woman as described below.
  - Inform receiving hospital (regional or tertiary).
  - Start one IV line with 200 mL Ringer's lactate/or 200 mL normal saline (whichever is available); run IV line slowly, it is just for access.
  - Start magnesium sulphate (4 g intravenous infusion (IVI) in 200 mL normal saline/Ringer's lactate over 20 minutes, plus 10 g intramuscular injection (IMI) (5 g in each buttock).[16,17]
  - Reduce high blood pressure with 10 mg quick-acting nifedipine orally. This can be repeated every 30 minutes if the blood pressure does not drop below 160/110 mmHg. If the woman is unable to swallow, place the 10 mg nifedipine under the woman's tongue.
  - Administer 1 g alpha-methyldopa orally.
  - Insert a urinary catheter and monitor urine output every hour until the woman is transferred.
  - Monitor the woman's BP, pulse and respiratory rate every 15 minutes until she is transferred.
  - Emergency transfer ideally accompanied by an experienced nurse if available. Use the SBAR (Situation, Background, Assessment, Recommendation) form to provide the necessary information.
  - Woman must be monitored and transferred in the **lateral position.**

## 7.2 District hospital (DH) with facilities for caesarean delivery

**7.2.1 Women with pre-hypertension (BP 135 - 139/85 - 89 mmHg)**

- Repeat blood pressure after rest (30 minutes - 2 hours); if still pre-hypertension, review in 3 days at PHC/CHC or DH (whichever most convenient).

**7.2.2 Women with hypertension without proteinuria**

- Start 500 mg alpha-methyldopa 8 hourly, and follow-up in 3 - 7 days to see if BP controlled.
- Investigate for pre-eclampsia: Hb, platelets, creatinine, liver enzymes (ALT) and sonar for fetal evaluation.
- Follow up weekly.

**7.2.3 Women with features suggestive of pre-eclampsia (e.g. HT <32 weeks, fetal growth restriction, isolated proteinuria, hypertension and proteinuria)**

- Confirm diagnosis.
- Ultrasound scan to estimate gestational age and fetal biometry.
- P/Cr ratio, MCS, Hb, platelets, creatinine, liver enzymes (ALT).
- Consider delivery or transfer to a higher level of care depending on the diagnosis and context (see below).

**7.2.4 Women with pre-eclampsia and severe features or eclampsia (referred or discovered)**

- Stabilise woman as described below.
  - Start one IV line with 200 mL Ringer's lactate/or 200 mL normal saline (whichever is available), run IV line slowly, it is just for access.
  - Start magnesium sulphate (4 g IVI in 200 mL normal saline/Ringer's lactate over 20 minutes, 10g IMI route (5 g in each buttock).[2,18]
  - Reduce high blood pressure with 10 mg quick-acting nifedipine orally. This can be repeated every 30 minutes if the blood pressure does not drop below 160/110 mmHg. If the woman is unable to swallow, put the 10 mg nifedipine under the woman's tongue.
  - Administer 1 g alpha-methyldopa orally.
  - Determine if the fetus is alive. Do not monitor the fetus.
  - ONLY monitor the fetus once the woman is stable and the decision has been taken that delivery is safe at a DH.
  - Insert a urinary catheter and monitor urine output every hour until the woman is transferred.
  - Monitor the woman's BP, pulse and respiratory rate, every 15 minutes until she is transferred.
  - Emergency transfer ideally accompanied by an experienced nurse if available. Use SBAR form.
  - Woman must be monitored and transferred in the **lateral position**
  - Transfer to highest available level of care (regional or tertiary – specialist O&G, anaesthetist care available).
  - Give steroids to stimulate fetal lung maturity if GA <34 weeks.
  - If in labour, stabilise and aim for delivery in DH, then transfer.

**7.2.5 GA <28 weeks and pre-eclampsia with no severe features and GA 28 - 33 weeks, pre-eclampsia with no severe features**

- Treat woman as in *Women with pre-eclampsia and severe features or eclampsia* (referred or discovered) (7.2.4).
- Transfer to higher level of care.
- Consult with referral hospital about steroids and magnesium sulphate.

**7.2.6 GA ≥34 weeks, pre-eclampsia with no severe features**

- Treat woman as in *Women with pre-eclampsia and severe features or eclampsia* (referred or discovered) (7.2.4).
- Ideally transfer to regional or tertiary hospital where specialist care is available.
- In special circumstances, the woman can be managed by the DH if sufficient expertise is available. This will be determined by the main hospital (regional or tertiary) in the catchment area.
- The woman must NOT be treated as an outpatient.

**7.2.7 Gestational hypertension (may be chronic; can only make diagnosis of chronic hypertension 6 weeks following delivery)**

- To be seen weekly at the antenatal clinic after screening bloods (Hb, platelets, creatinine, sonar for fetal evaluation to exclude pre-eclampsia).
- For delivery at 38 - 40 weeks at DH.[19]

**7.2.8 Severe hypertension and pre-eclampsia with severe features or eclampsia (managed in regional or tertiary hospitals – main hospital in catchment area)**

- Stabilise woman as in *Women with pre-eclampsia and severe features or eclampsia* (referred or discovered) (7.2.4).
- Magnesium sulphate
  - IM regimen (Pritchard).
  - IV if feasible.
- Preferred option for severe hypertension: Anti-hypertensive therapy
  - Oral nifedipine (10 mg) cheaper, easier.
  - IV labetalol expensive, advantage that it forces monitoring.
  - IV dihydralazine or hydralazine but difficult to procure.
  - Use nifedipine or labetalol as second line if first choice not effective
  - Alpha-methyldopa should be started on admission, if not already on it. Give 1 g loading dose and thereafter 750 mg 8-hourly. This is to ensure smoother blood pressure control later, and is NOT for immediate control of severe hypertension.
- Fluids
  - Magnesium sulphate bolus: 4 g in 200 mL over 20 minutes.
  - Ringer's lactate 80 mL/hour maximum.[3,21]
  - If urine output drops to <25 mL/hour, one additional bolus of 200 mL can be given.
- Fetal monitoring
  - Determine if the fetus is alive on admission.
  - ONLY monitor the fetus once the woman is stable.
- Delivery
  - If eclamptic or HELLP or organ dysfunction, steps for delivery should be initiated as soon as woman is stabilised.
  - Initiate if 34 week's gestation.
  - Consider giving corticosteroids and initiate delivery after 48 hours if between 28 - 33 weeks, provided woman is stable (no eclampsia, no HELLP, normal platelets and creatinine, and BP controlled easily with disappearance of symptoms).

For any pre-eclampsia at term, or preterm pre-eclampsia with serious maternal complications (e.g. eclampsia, CVA, pulmonary oedema, uncontrollable severe hypertension, renal dysfunction (creatinine >120 mmol/L), coagulopathy (platelets <100 000 × $10^9$/L twice)), pregnancy termination should be 'strongly advised'.

For pre-eclampsia preterm without serious maternal complications (>34 weeks), termination of pregnancy should be 'offered' with a full explanation of the trade-off between limiting the risk to the mother of disease progression and compromising the baby's health due to premature birth.[22] (Where possible, the family, e.g. husband, partner, mother should be included in the discussion). When the maternal and fetal status is stable and gestation is <34 weeks, expectant care may be offered after careful counselling at a tertiary facility under specialist care. It should be emphasised that, while survival is usual after 34 weeks' gestation, preterm birth even after 34 weeks is associated with neurological impairment.

Informed consent is required for either termination of pregnancy or expectant management where delivery would otherwise effect a cure from a life-threatening illness within 24 hours in most cases

**Note:** It is critical to control the blood pressure and every effort must be made to do this within a reasonable timeframe.

## 8. Other issues

### 8.1 Induction of labour in pre-eclampsia or eclampsia

- With eclampsia, delivery is urgent and there is a time consideration (about 6 hours to stablish labour and then delivery within 12 hours from initiation of induction).
- Can be considered if cervix favourable, depending on evaluation of maternal complications. Requires high-care monitoring throughout. Availability of skilled doctors and facilities for safe for CD must also be considered. Induction of labour is appropriate especially where CD is less safe.
- All women with eclampsia should be in facilities where a safe CD can be performed.
- Without eclampsia, induction of labour reasonable even if cervix is not favourable.

### 8.2 Vaginal birth in pre-eclampsia or eclampsia

- No need for elective assisted delivery.
- If blood pressure is not controlled before pushing, consider shortening second stage with forceps or vacuum.

### 8.3 Postoperative and postpartum care in pre-eclampsia or eclampsia

- Early warning monitoring chart (coloured monitoring charts) must be used in a high-care area.
- Consider venous thromboembolism (VTE) taking into account appropriate clinical features, i.e. weight, duration of hospital stay, platelet counts, BP stabilisation and discuss with a specialist obstetrician and anaesthesiologist etc.
- Never discharge home before 24 hours.
- Continue magnesium sulphate up to 24 hours after delivery or 24 hours after last fit.
- Keep women with eclampsia and those with organ dysfunction for at least 3 days.
- Do not routinely stop anti-hypertensive drugs abruptly; do a step-wise reduction in dose or withdrawal of one type of anti-hypertensive if on more than one drug.
- Antihypertensive drug of choice: calcium channel blockers and/or diuretic (>48 hours). ACE inhibitors and diuretics can be used in combination postpartum.
- Ensure appropriate contraception is provided.

Prior to discharge, all women with pre-eclampsia/eclampsia should have counselling, especially if a complication and pregnancy loss has occurred. Information about future pregnancies and long-term outcomes (risks of developing pre-eclampsia/eclampsia and/or other cardiovascular complications in the future) should be disseminated.[23-25]

### 8.4 Long-term follow-up

- Depending on where the woman lives, follow up at hospital or CHC after 1 week.

- Recommend 3-monthly follow-up.
- Psychological health counselling and support should be provided.[24]

### 8.5 Anaesthetic considerations (regional, tertiary, possibly district-level in special circumstances agreed by the main hospital in the catchment area)

- Stabilise patient – aim for BP ≤140/90 mmHg, MUST be <160/110 mmHg.
- Discuss with anaesthetist at regional or tertiary hospital.
- Regional (spinal or epidural) is anaesthetic of choice, if applicable.
- Check Hb, platelets.
- Platelets ordered on standby if platelet count <50 000 × $10^9$/L.
- General anaesthetic recommended if:
  - Platelet count <75 000 × $10^9$/L in last 6 hours, or platelet count not available.

  This is a contentious issue, as very often the airway poses potential difficulty. **IF** a specialist anaesthetist is directly involved with the case, and pencil-point spinal needles are available, a platelet count of 50 000 × $10^9$/L **MAY** be considered as the cut-off. In addition, the time since the performance of the platelet count may be increased to 12 hours, with the proviso that a risk-benefit discussion occurs, particularly in pre-eclampsia with severe features, where the platelet count may drop catastrophically, and a spinal anaesthetic may render the management of a bleeding patient very difficult.
  - Glasgow Coma Scale (GCS) <14.
  - Congestive cardiac failure.

- If general anaesthesia administered:
  - Magnesium to attenuate intubation response and/or opiates.
  - Fluid restriction or goal-directed fluid therapy; preloading is **NOT** recommended.
  - Multimodal analgesia – local infiltration, paracetamol, opiates, not non-steroidal anti-inflammatory drugs (NSAIDs).
  - Lignocaine to attenuate extubation response unless entral nervous system concerns.

In **ALL** patients the syntocinon should be given at a reduced infusion rate. **ALL** patients require an acute-care bed, arranged in consultation with the obstetrician.

**Note:** These are guidelines, and each patient with pre-eclampsia/eclampsia needs to be assessed on merit, taking into account the following: blood pressure control; cardiac function; neurological status; platelet count and bleeding status; as well as the airway.

## 9. Implementing the 2019 Managing Hypertensive Disorders of Pregnancy Guidelines

The aim of this document is to effect the decisions taken by the National Health Council (NHC). The key findings and decisions are summarised below.

### 9.1 Saving Mothers Report 2017: Report on key decisions taken by the National Health Council, 6 - 7 December 2018

**Summary of key findings**

- Institutional maternal mortality ratio (iMMR) has levelled off since 2015.
- Impact of ARVs maximised but NPRIs still high owing to deaths from TB and atypical pneumonia.
- Deaths from OH have started to decline.
- Deaths from HDP not declining (some indication that it is climbing). HDP is also associated with high numbers of stillbirths and neonatal deaths.
- The predominant challenge is insufficient and poorly skilled doctors and nurses, especially in DHs in more rural areas, as well as non-use of standardised clinical protocols in tertiary and national central hospitals.

### 9.2 Decisions by the National Health Council (consisting of the Minister, Director General (DG), and Provincial Ministers of Health and their DGs) relating to HDP

- Strengthen information, diagnosis and treatment of HDP
  - Ensure that all clinics have protocols and guidelines (including referral).
  - Members of the district clinical specialist teams (DCSTs) to ensure that clinical protocols are available and are used (and

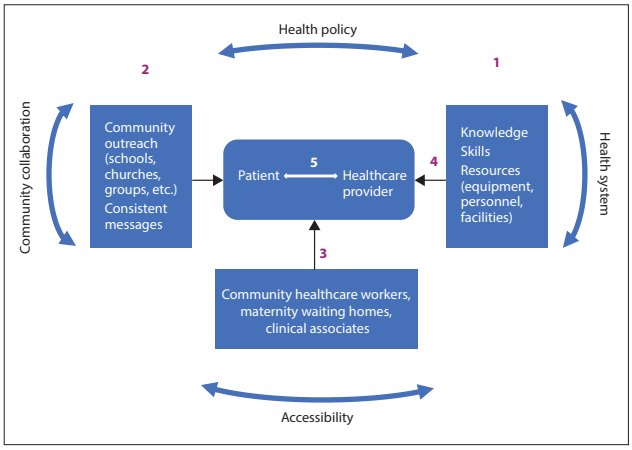


*Fig. 10. Implementing a new intervention.*

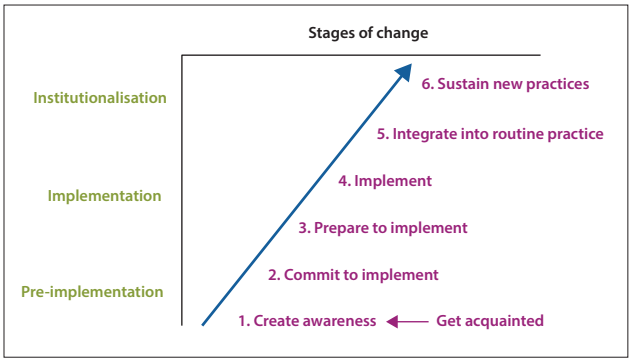


*Fig. 11. Stages of change: Pre-implementation to institutionalisation.*

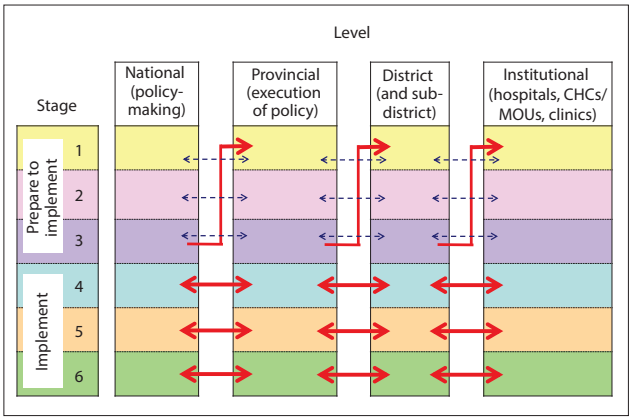


*Fig. 12. Stages of change for implementing Department of Health recommendations. (CHC = community healthcare centre; MOU = midwife obstetric unit.)*

provide training in the use of protocols where necessary). DCSTs should also ensure that referral indicators and referral patterns are available and used at primary healthcare levels.
  - Train nurses to manage/initiate treatment for HDP immediately (especially that of severe hypertension) and refer pregnant women with hypertension timeously.
  - Ensure that sufficient and functional BP machines are available at all clinics.
  - Provide calcium carbonate as part of antenatal care to prevent HDP and provide low-dose aspirin for those at risk of HDP.
  - Speak to Department of Basic Education (DBE) about providing information to all learners about reproductive health matters and to ensure pregnant learners' BP is measured regularly.
  - Minister to issue a circular to clinical managers on the management of staff, especially sessional doctors, and the availability and use of clinical protocols for the management of hypertension.

Implementing a new or updated guideline requires that all the interfaces involving the pregnant woman must be addressed, as shown in Fig. 10. The interfaces with their actions are listed below and all need to be dealt with to ensure full implementation.[26]

- Policy makers ↔ Healthcare managers
  - Direction and resources
- Policy makers ↔ Community
  - Educational messages
- Community ↔ Healthcare managers
  - Accessibility
- Healthcare managers ↔ Healthcare professionals
  - Training and resources
- Healthcare professionals ↔ Healthcare user
  - Change behaviour

Each time a new or updated guideline is introduced, **each interface** must go through the 'stages of change' as shown in Figs 11 and 12. These principles have been successfully used to implement the Essential Steps in Managing Obstetric Emergencies (ESMOE). The implementation of ESMOE in the 12 districts studied resulted in a 29% reduction in all maternal deaths and an 18% reduction in direct maternal deaths.[27]

Table 3 provides a summary of the actions required to implement the updated guidelines for managing HDP, per interface as agreed by the NDoH on 23 January 2019.

The **major obstacles** for the implementation of the guideline will be:

- Establishing systems for the **next level of expertise**. Training programmes for the next level of expertise are available and should be requested from the NDoH cluster.

**Table 3. Actions required to implement the updated guidelines for managing hypertensive disorders in pregnancy per interface**

| Interface | Level of interaction | Action | Facilitator | Motivation |
|---|---|---|---|---|
| 1. Policy | NDoH, politicians, civil society, professional bodies | • Speak to DBE about providing information to all learners about reproductive health matters and to ensure pregnant learners ave their BP measured regularly.<br>• Minister to issue a circular to clinical managers on the management of staff, especially sessional doctors and the availability and use of clinical protocols on management of hypertension.<br>• Each MEC to ensure the provincial HODs circulate the HDP Guidelines and obtain feedback as to the implementation process. | Advisors, chairpersons of ministerial committees | • HDP is the most potentially preventable condition that causes maternal deaths in SA.<br>• It also is the most common cause of preventable stillbirths and neonatal deaths. |
| 2. Healthcare promotion messages | NDoH, PDoH | Ensure consistent messages<br>• Attend clinic as soon as the woman thinks she is pregnant<br>• Blood pressure and urine must be tested at each visit<br>• The woman should attend the antenatal clinic at least 8 times, but especially every second week in the third trimester<br>• Every pregnant woman should be taking 500 mg of calcium daily<br>• Pregnant women at risk of HDP should receive low-dose aspirin daily during pregnancy.<br>MomConnect should be used for this. | Chairpersons of ministerial committees, national MCWH cluster | • Early attendance at antenatal clinics allows early detection of complications.<br>• Measuring the blood pressure and testing the urine for protein at each visit is essential for early detection of HDP.<br>• The increased visits in the third trimester has led to an increase in detection of HDP.<br>• Calcium and aspirin shown to reduce HDP and its severity. |

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**Table 3. (continued) Actions required to implement the updated guidelines for managing hypertensive disorders in pregnancy per interface**

| Interface | Level of interaction | Action | Facilitator | Motivation |
|---|---|---|---|---|
| 3. Communication with the community | PDoH, districts, ward PHC team, school health programme, DBE | All healthcare professionals and those who regularly come into contact with pregnant women should give the consistent messaging shown above. | National MCWH cluster, MomConnect manager | • Currently, less than half the pregnant population attend early antenatal clinics and at least 8 times during pregnancy. |
| 4. Access to care by the community | PDoH, district, ward PHC team, district Clinicians | Ensure each PHC and any other clinic managing pregnant women have the following:<br>• At least two functioning blood pressure machines<br>• Urine dipsticks for testing urine for protein<br>• A functional system for referral of pregnant women with HDP. | Provincial MCWH directors, district clinicians | • Without a functioning blood pressure machine and urine dipsticks, there can be no effective screening for HDP.<br>• Lack of referral of women with HDP is the most common healthcare professional-avoidable factor related to perinatal deaths. |
| 5. Appropriate allocation of resources to health system | NDoH, PDoH, District | Ensure that each PHC and any other clinic managing pregnant women have:<br>• Functioning blood pressure machines<br>• Urine dipsticks for testing protein<br>• 500 mg calcium tablets given to every pregnant woman irrespective of gestational age<br>• 150 mg aspirin given to women at risk of developing HDP<br>• Magnesium sulphate<br>• Nifedipine<br>• Alpha-methyldopa<br>• A next level of expertise; this may be a specially trained healthcare professional at the clinic or visiting the clinic regularly may require referral to the next level of care<br>• Transport for women being referred to another healthcare facility. | National and Provincial MCWH directors | • Without equipment, screening cannot be performed.<br>• Without calcium and aspirin, prevention of HDP cannot be performed.<br>• Without having the next level of expertise available, pregnant women will not receive appropriate treatment. |
| 6. Knowledge and skills of healthcare provider | PDoH, district, district clinicians, ward PHC team | • Ensure every healthcare professional that deals with pregnant women is familiar with the updated HDP management guidelines.<br>• Each clinic has the **appropriate protocols** displayed prominently in the clinics/labour wards.<br>• Every healthcare professional is aware of the system of referral to the **next level of expertise.** | District clinicians, MCWH co-ordinators | • See above.<br>• Lack of recognition and lack of evaluation of pregnant women with HDP are the most frequent avoidable factors related to the primary level of care.<br>• Delayed or lack of referral is the second most common avoidable factor in managing women with HDP. |
| 7. Consultation skills | District, district clinicians | • Ensure pregnant women are treated with respect.<br>• Ensure healthcare professionals have the required level of knowledge and skills to detect and manage HDP for their level of care. | District clinicians | • Lack of knowledge and skills in managing HDP is one of the most common avoidable factors at **all** levels of care. |

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**Table 3. (continued) Actions required to implement the updated guidelines for managing hypertensive disorders in pregnancy per interface**

| Interface | Level of interaction | Action | Facilitator | Motivation |
|---|---|---|---|---|
| 8. Monitoring and evaluation | MCWH co-ordinators, district clinicians, district, PDoH | This will take place at various levels. Each indicator must be reported on to the appropriate person on a regular stipulated basis.<br>**Antenatal care**<br>**Ward sister** at the delivery site to take the first 20 files of women discharged and count how many times the pregnant women attended antenatal clinic and to note the gestational age at starting antenatal care. This must be reported monthly to the **sister in charge of the maternity unit**. The sister in charge of the maternity unit must feed this to the **MCWH co-ordinator for the sub-district/district** each month.<br>**Clinic sister in charge of the antenatal clinic** to document the number of women referred to the next level of expertise each month. This must be reported to the **Clinic Manager** monthly who in turn should report to the **MCWH co-ordinator for the sub-district/district** each month.<br>**The healthcare professional at the next level of expertise** must report the number of patients seen per month and how many were referred to the **next higher level of care.** These data should go to the **MCWH co-ordinator for the sub-district/district** each month.<br>**The MCWH co-ordinator for the sub-district/district** should inspect each clinic monthly and report on:<br>• Number of functioning blood pressure machines<br>• Availability of urine dipsticks<br>• Take 5 antenatal charts to see if the woman is receiving 500 mg calcium daily<br>• See that the protocol for HDP is prominently displayed<br>• Question one member of staff on what they would do if they found a pregnant woman with hypertension. The correct answer should be assessed according to the displayed protocol.<br>**The MCWH co-ordinator for the sub-district/district** must report to **district management** at their quarterly meetings on:<br>• The proportion of pregnant women who have 8 or more antenatal visits<br>• The proportion of pregnant women who booked before 20 weeks' gestation<br>• Number and names of clinics with and without functioning blood pressure machines, urine dipsticks and calcium supplementation<br>• Number and names of clinics with and without the HDP protocol prominently displayed at the antenatal clinic<br>• Number of referrals to the next level of expertise<br>• Number of referred patients seen at the next level | District clinicians, MCWH co-ordinators, district managers, DCSTs, provincial NCCEMD representatives, provincial NaPeMMCo representatives and chairpersons of the NCCEMD and NaPeMMco. | • Without monitoring and evaluation, there will be no accountability. Those not implementing their required actions must be held to account. |

...continued

**Table 3. (continued) Actions required to implement the updated guidelines for managing hypertensive disorders in pregnancy per interface**

| Interface | Level of interaction | Action | Facilitator | Motivation |
|---|---|---|---|---|
| | | • Any maternal or perinatal death associated with HDP and the avoidable factors related to each case.<br>The **sister in charge of the labour ward/maternity unit** must report monthly on:<br>• The number of women with HDP managed at the unit<br>• The number of women with hypertension, proteinuria, a blood pressure of 160 mmHg systolic or 110 mmHg diastolic, and/or symptoms of imminent eclampsia or eclampsia<br>• The outcome of pregnancy (baby and mother alive and well, referred or died)<br>• Each maternal and perinatal death must be recorded in detail on the Maternal Death Notification form and the PPIP form<br>• For each death, there must be a review and the DCST should be present for the reviews<br>• The number of EOST exercises conducted in the month. One should be on HDP.<br>The sister in charge should present the information to the **CEO of the hospital** or **HOD of the Department of Obstetrics and Gynaecology** monthly. The CEO or HOD should present the information at the quarterly **district management** meeting.<br>At the **district management meeting**, notes must be made of what has been done to correct the problems identified, and individual people identified to carry out actions and who should report back at the next management meeting.<br>The **DCST** must identify problem issues at the **district management meeting**, present a **plan** for their remediation and present the **results** of the remediation at the next district management meeting.<br>The **district manager** must report quarterly to the **provincial MCWH director**:<br>• The proportion of pregnant woman who have 8 or more antenatal visits for the district<br>• The proportion of pregnant women who booked before 20 weeks' gestation for the district<br>• Number and names of clinics with and without functioning blood pressure machines, urine dipsticks and calcium supplementation<br>• Number and names of clinics with and without the HDP protocol prominently displayed at the antenatal clinic<br>• The number of women diagnosed with hypertension (data from ward sister in charge of the labour ward/maternity unit)<br>• The number of women diagnosed with hypertension, proteinuria, a blood pressure of 160 mmHg systolic or 110 mmHg diastolic, and/or symptoms of imminent eclampsia or eclampsia (data from ward sister in charge of the labour ward/maternity unit)<br>• The number of maternal deaths and avoidable factors<br>• The number of perinatal deaths and avoidable factors<br>• The **plans** to correct any problems identified in equipment or knowledge and skills of the healthcare professionals. The **results** of the interventions must be presented at the next provincial quarterly meeting.<br>The **provincial MCWH Director** must present to **the national MNCH director:**<br>• The proportion of pregnant woman who have ≥8 antenatal visits for the province<br>• The proportion of pregnant women who booked before 20 weeks' gestation for the province<br>• Number and names of districts with and without functioning blood pressure machines, urine dipsticks and calcium supplementation<br>• Number and names of districts with and without the HDP protocol prominently displayed at the antenatal clinic | | |

...continued

**Table 3. (continued) Actions required to implement the updated guidelines for managing hypertensive disorders in pregnancy per interface**

| Interface | Level of interaction | Action | Facilitator | Motivation |
|---|---|---|---|---|
| | | • The number of women diagnosed with hypertension<br>• The number of women diagnosed with hypertension, proteinuria, a blood pressure of 160 mmHg systolic or 110 mmHg diastolic, and/or symptoms of imminent eclampsia or eclampsia<br>• The number of maternal deaths and avoidable factors<br>• The number of perinatal deaths and avoidable factors<br>• The **plans** to correct any problems identified in equipment or knowledge and skills of the healthcare professionals. The **results** of the interventions must be presented at the next national quarterly meeting<br>• The **provincial facilitators for the National Committee for the Confidential Enquiries into Maternal Deaths** (NCCEMD) will present at the quarterly NCCEMD meeting the number of maternal deaths due to HDP, the avoidable factors and the **plans** taken to rectify the problem. At the next meeting, the provincial facilitator will report on the **results** of the plans.<br>The **provincial facilitator for the NaPeMMCo** will report on the number of perinatal deaths due to HDP, the avoidable factors and the **plans** taken to rectify the problem. At the next meeting, the provincial facilitator will report on the **results** of the plans.<br>The **NCCEMD and NaPeMMCo chairpersons** will report 6-monthly on the number of maternal and perinatal deaths due to HDP, the avoidable factors and the **plans** taken to rectify the problem to the **National Minister of Health or his/her representative**. At the next meeting, the chairpersons of the committees will report on the **results** of the plans. | | |

NDoH = National Department of Health; DBE = Department of Basic Education; HOD = head of department; HDP = hypertensive disorders of pregnancy; PDoH = Provincial Department of Health; MCWH = Maternal, Child and Women's Health; PHC = primary healthcare clinic; DCSTs = district clinical specialist teams; MNCH = Maternal, Newborn and Child Health; EOST = Emergency Obstetric Simulation Training; PPIP = Perinatal Problem Identification Program; NCCEMD = National Committee for the Confidential Enquiries into Maternal Deaths; NaPeMMCo = National Perinatal Morbidity and Mortality Committee.

- Ensuring **protocols** derived from the **guideline** are available at each clinic and labour ward. The DCSTs must be responsible for developing these protocols with clinics and hospitals in the catchment area.

An implementation pack, which includes the relevant documentation and slide presentations, will be available at the start of the implementation process. Further algorithms will be available in the implementation pack for each level of care for easy reference.

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1. Moodley J. Maternal deaths due to hypertensive disorders of pregnancy: Data from the 2014 - 2016 Saving Mothers' Report. Obstet Gynecol Forum 2018; 28(3):28-32.
2. South African National Department of Health (NDoH). The 2017 Annual Saving Mothers Report. Pretoria: NDoH; 2017:5.
3. Kredo T, Wiseman R, Gray A, et al., How good are our guidelines ? Four years of experience with SAMJ's AGREE 11 review of submitted clinical practice guidelines. S Afr Med J 2018;108(11):883-885. https://doi.org/10.7196/SAMJ.2018v108i11.13646.
4. Brown MA, Magee LA, Kenny LC, et al. The hypertensive disorders of pregnancy: ISSHP classification, diagnosis and management recommendations for international practice. Preg Hypertension 2018;13:291-310. https://doi.org/10.1016/j.preghy.2018.05.004
5. Nathan HL, Boene H, Munguambe K, et al. The CRADLE vital signs alert: Qualitative evalutation of a novel device designed for use in pregnancy by healthcare workers in low-resource settings. Reprod Health 2018;15(1):5. https://doi.org/10.1186/s12978-017-0450-y
6. Hofmeyr GJ, Lawrie TA, Atallah AN, Torloni MR. Calcium supplementation during pregnancy for preventing hypertensive disorders and related problems. Cochrane Database Syst Rev 2018;10:CD001059. https://doi.org/10.1002/14651858.CD001059.pub5
7. Cade TJ, Gilbert SA, Polyakov A, Hotchin A. The accuracy of spot urinary protein-to-creatinine ratio in confirming proteinuria in pre-eclampsia. Aust N Z J Obstet Gynaecol 2012;52(5):179-182. https://doi.org/10.1111/j.1479-828X.2011.01409.x
8. Phelan IK, Brown MA, Davis GK, Mangos G. A prospective study of the impact of automated dipstick urinanalysis on the diagnosis of pre-eclampsia. Hypertension Preg 2004;23(2):135-142. https://doi.org/10.1081/PRG-120022821089
9. Cote AM, Brown MA, Lam EM, et al. Diagnostic accuracy of urinary spot protein:creatinine ratio for proteinuria in hypertensive pregnant women: Systematic review. BMJ 2008;336(7651):1003-1006. https://doi.org/10.1136/bmj.39532.543947.BE
10. Bartsch E, Medcalf KE, Park AL, et al. Clinical risk factors for pre-eclampsia determined in early pregnancy: Systematic review and meta-analysis of large cohort studies. BMJ 2016;353:i753. https://doi.org/10.1136/bmj.i1753
11. Rolnik DL, Wright D, Poon IC, et al. Aspirin versus placebo in pregnancies at high risk for preterm preeclampsia. N Engl J Med 2017;377(7):613-622.
12. Bujold E, Roberge S, Lacasse Y, et al. Prevention of preeclampsia and intrauterine growth restriction with aspirin started in early pregnancy: A meta-analysis. Obstet Gynecol 2010;116(2 Pt 1):402-414. https://doi.org/10.1097/AOG.0b013e3181e9322a
13. Hofmeyr GJ, Mentrop L. Time for 'basic ante-natal care plus' in South Africa? S Afr Med J 2015;105(11);902-903. https://doi.org/10.7196/SAMJ.2015.v105i11.10186.
14. Fakier A, Petro G, Fawcus S. Mid-upper arm circumference: A surrogate for body mass index in pregnant women. S Afr Med J 2017;107(7):606-610. https://doi.org/10.7196/SAMJ.2017.v107i7.12255
15. Magee LA, von Dadelszen P, Rey E, et al. Less-tight versus tight control of hypertension in pregnancy. N Engl J Med 2015;372(5):407-417. https://doi.org/10.1056/NEJMoa1404595
16. Hawkins LA, Brown MA, Mangos GJ, Davis GK. Transient gestational hypertension: Not always a benign event. Pregnancy Hypertens 2012;2(1):22-27. https://doi.org/10.1016/j.preghy.2011.09.001
17. Magee LA, von Dadelszen P, Singer J, et al. The CHIPS randomised controlled trial (control of hypertension in pregnancy). Is severe hypertension just an elevated blood pressure? Hypertension 2016;68(5):1153-1159. https://doi.org/10.1161/HYPERTENSIONAHA.116.07862
18. Duley L, Gulmezoglu A, Henderson-Smart DJ, Chou D. Magnesium sulphate and other anticonvulsants for women with pre-eclampsia. Cochrane Database Syst Rev 2010:CD 000025. https://doi.org/10.1002/14651858
19. Magpie Trial Group. Do women with pre-eclampsia and their babies benefit from magnesium sulphate? The Magpie Trial: A randomised placebo-controlled trial. Lancet 2002;359(9321):1877-1890. https://doi.org/10.1016/50140-6736(02)08778-0
20. Cruz MO, Gao W, Hibbard JU. What is the optimal time for delivery in women with gestational hypertension? Am J Obstetr Gynecol 2012;207(3):214e1-6. https://doi.org/10.1016/j.ajog2012.06.009
21. Brown MA, Gallery EDM. Volume homeostasis in normal pregnancy and pre-eclampsia: Physiology and clinical implications. Balliere's Clin Obstet Gynecol 1994;8(2):287-310.
22. Gillon TE, Pels A, von Dadelson P, MacDonell K, Magee LA. Hypertensive disorders of pregnancy: A systematic review of international clinical practice guidelines, PLoS One 2014;9(12):e113715. https://doi.org/10.1371/journal.pone.0113715.
23. Bellamy L, Casas JP, Hingorani AD, Williams D. Pre-eclampsia and risk of cardiovascular disease and cancer in later life: Systematic review and meta-analysis. BMJ 2007;335(7627):974. https://doi.org/10.1136/bmj.39335.3853011.BE.
24. Soma-Pillay P, Louw MC, Adeyemo AO, Makin J, Pattinson RC. Cardiac diastolic function after recovery from pre-eclampsia. Cardiovasc J Afr 2018;29(1):26-31. https://doi.org/10.5830/CVJA-2017-031
25. Soma-Pillay P, Makin JD, Pattinson R. Quality of life 1 year after a maternal near miss event. Int J Obstet Gynecol 2018;141(1):133-138. https://doi.org/10.1002?ijo.12432
26. Pattinson RC, Kerber K, Buchmann E, et al. Stillbirths: How can health systems deliver for mothers and babies? Lancet 201;377(9777):1610-1623. https://doi.org/10.1016/s0140-6736(10)62306-9
27. Pattinson RC, Bergh A-M, Ameh C, et al. Reducing maternal deaths by skills-and-drills training in managing obstetric emergencies: A before-and-after observational study. S Afr Med J 2019;109(4):241-245. https://doi.org/10.7196/SAMJ.2019.v109i4.13578