National Institute for Health and Care Excellence

FINAL

Antenatal care

[K] Identification of hypertension in pregnancy

NICE guideline NG201

Evidence reviews underpinning recommendations 1.2.26 to 1.2.29

August 2021

Final

These evidence reviews were developed by the National Guideline Alliance, which is a part of the Royal College of Obstetricians and Gynaecologists

Disclaimer

The recommendations in this guideline represent the view of NICE, arrived at after careful consideration of the evidence available. When exercising their judgement, professionals are expected to take this guideline fully into account, alongside the individual needs, preferences and values of their patients or service users. The recommendations in this guideline are not mandatory and the guideline does not override the responsibility of healthcare professionals to make decisions appropriate to the circumstances of the individual patient, in consultation with the patient and/or their carer or guardian.

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ISBN: 978-1-4731-4227-5

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Identification of hypertension in pregnancy

Review question

What is the most effective way of measuring blood pressure (including setting and technique) using validated equipment to identify a hypertensive disorder of pregnancy?

Introduction

Hypertension in pregnancy is common but if not managed appropriately can lead to adverse outcomes. Thus, it is important to accurately and quickly identify hypertension during pregnancy. This allows for appropriate treatment and monitoring of conditions like pre-eclampsia, and timely plans to be made to expedite birth where indicated. Blood pressure measurement can be done in a wide range of settings and using a variety of techniques. Each of these may have an impact on accuracy (and therefore downstream clinical consequences for women) and the burden involved with regular testing. The aim of this review is to find out what is the most effective way of measuring blood pressure to identify hypertensive disorder of pregnancy.

Summary of the protocol

See **Table 1** for a summary of the Population, Intervention, Comparison and Outcome (PICO) characteristics of this review.

Table 1: Summary of the protocol (PICO table)

Population	All pregnant women
Intervention	**Setting** • Self or home measurement (automated monitoring or non-automated monitoring) • Ambulatory blood pressure (BP) measurement **Technique** • Auscultatory • Korotkoff phase IV to represent diastolic BP • Korotkoff phase V to represent diastolic BP • Resting for at least 5 minutes from arrival at clinic prior to measurement • Single measurement • Multiple measurements • Appropriate cuff size • Universal cuff size
Comparison	Any of the above compared with any other, alone or in combination
Outcome	**Critical** • Systolic BP ≥150 mmHg • Maternal mortality • Perinatal mortality (neonatal death/stillbirth) • Preterm birth **Important** • Maternal morbidities (e.g. pre-eclampsia) • Measures of maternal quality of life ○ Maternal experiences and views of the interventions

	○ Maternal anxiety ○ Maternal self-confidence • Maternal use of health service resources ○ Number of clinic visits ○ Number of antenatal hospital admissions ○ Induction of labour ○ Operative delivery ○ Intensive care admission ○ Ventilation ○ Dialysis • Neonatal use of health service resources ○ Admission to special care nursery and length of stay ○ Endotracheal intubation and use of mechanical ventilation

BP: blood pressure

For further details see the review protocol in appendix A.

Methods and process

During the development of this guideline, a registered Cochrane protocol was identified which matched the committee's intended PICO. The Cochrane review team completed their review (Ashworth 2020) during guideline development and presented their results to the guideline committee which used them to make recommendations. Cochrane's methods are closely aligned to standard NICE methods, minor deviations (the use of the original Cochrane risk of bias tool, use of GRADE only on main outcomes with no overall quality rating for those with zero events in either arm, defining primary and secondary outcomes as opposed to critical and important and including countries from a broader range of income categories than the majority of the other reviews in the guideline) relevant to the topic area were highlighted to the committee and taken into account in discussions of the evidence.

Declarations of interest were recorded according to NICE's conflicts of interest policy.

Clinical evidence

Included studies

One Cochrane review (Ashworth 2020) including 3 randomised controlled trials (Brown 1998, Pealing 2019, Vousden 2019) was considered in this report. This review was used for recommendation making by the committee as it was considered sufficiently relevant, high quality and up to date.

The Cochrane review is summarised in Table 2 and the results of the review summarised in evidence statements in this report, however full details of the Cochrane review including methods are available here https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD012739.pub2/full.

See the Cochrane review for the literature search strategy, study selection flow chart, forest plots and GRADE tables.

Excluded studies

See the Cochrane review for the list of excluded studies with reasons for their exclusions

Summary of studies included in the evidence review

Summaries of the studies that were included in this review are presented in Table 2.

Table 2: Summary of included studies

Study	Population	Comparisons	Outcomes
Ashworth 2020 Systematic review	Number of studies = 3 Number of women = 536,607	Self-measurement versus conventional clinic measurement 1 RCT, N = 154 women, UK, Pealing 2019 Korotkoff phase IV versus Korotkoff phase V to represent diastolic BP 1 RCT, N = 220 women, Australia, Brown 1998 Auscultatory technique versus automated technique to measure BP 1 RCT, Ethiopia, Sierra Leone, Zimbabwe, Uganda, Zambia, Malawi, India and Haiti, N = 536,233 deliveries, Vousden 2019	• Systolic BP greater than or equal to 150mmHg • Maternal death • Maternal morbidity • Neonatal death • Neonatal morbidity • Antenatal clinic visits • Antenatal hospital admissions • Induction of labour • Operative delivery • Maternal admission to intensive care • Maternal length of stay in intensive care • Ventilation • Dialysis • Neonatal unit admission • Neonatal unit length of stay • Endotracheal intubation and use of mechanical ventilation • Maternal experiences and views of the interventions • Maternal anxiety • Maternal self-confidence

BP: blood pressure

See the Cochrane review for full evidence tables.

Quality assessment of studies included in the evidence review

See the Cochrane review for GRADE tables.

Economic evidence

Included studies

A systematic review of the economic literature was conducted but no economic studies were identified which were applicable to this review question.

A single economic search was undertaken for all topics included in the scope of this guideline. See supplementary material 2 for details.

Excluded studies

There was no economic evidence identified for this review question and therefore there is no excluded studies list in appendix K.

Summary of included economic evidence

No economic studies were identified which were applicable to this review question.

Economic model

No economic modelling was undertaken for this review because the committee agreed that other topics were higher priorities for economic evaluation.

Evidence statements

Clinical evidence statements

The evidence statements below correspond to the outcomes assessed using the GRADE approach in the Cochrane review. For all other outcomes, none of which showed a statistically significant or clinically important difference, see the full Cochrane review: https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD012739.pub2/full

Comparison 1. Self-measurement (using an automated BP device at home) versus conventional clinic measurement

Critical outcomes

Systolic BP ≥150 mmHg

No evidence was identified to inform this outcome.

Maternal death

- One RCT (N=154) showed no clinically important difference in maternal deaths between those self-measuring BP versus conventional clinic measurement (none in either arm).

Neonatal death

- Low quality evidence from 1 RCT (N=154) showed no clinically important difference in neonatal death between those self-measuring BP versus conventional clinic measurement: RR 1.54 (95% CI 0.06 to 37.25).

Stillbirth

- Low quality evidence from 1 RCT (N=154) showed no clinically important difference in stillbirth between those self-measuring BP versus conventional clinic measurement: RR 2.57 (95% CI 0.13 to 52.63).

Preterm birth

- Low quality evidence from 1 RCT (N=154) showed no clinically important difference in preterm birth between those self-measuring BP versus conventional clinic measurement: RR 1.15 (95% CI 0.37 to 3.55).

Important outcomes

Pre-eclampsia

- Low quality evidence from 1 RCT (N=154) showed no clinically important difference in pre-eclampsia between those self-measuring BP versus conventional clinic measurement: RR 1.49 (95% CI 0.87 to 2.54).

Maternal admission to intensive care

- Low quality evidence from 1 RCT (N=154) showed no clinically important difference in maternal admission to intensive care between those self-measuring BP versus conventional clinic measurement: RR 1.54 (95% CI 0.06 to 37.25).

Induction of labour

- Low quality evidence from 1 RCT (N=154) showed no clinically important difference in induction of labour between those self-measuring BP versus conventional clinic measurement: RR 1.09 (95% CI 0.82 to 1.45).

Neonatal unit admission

- Low quality evidence from 1 RCT (N=154) showed no clinically important difference in neonatal unit admission between those self-measuring BP versus conventional clinic measurement: RR 1.53 (95% CI 0.65 to 3.62).

Number of maternal antenatal hospital admissions

No evidence was identified to inform this outcome.

Neonatal unit length of stay

No evidence was identified to inform this outcome.

Neonatal endotracheal intubation and use of mechanical ventilation

No evidence was identified to inform this outcome.

Outcomes reported, showing no difference but not assessed with GRADE

Eclampsia, HELLP syndrome, operative delivery

Comparison 2. Korotkoff phase IV versus Korotkoff phase V to represent diastolic BP

Critical outcomes

Systolic BP ≥150 mmHg

No evidence was identified to inform this outcome.

Maternal death

- One RCT (N=220) showed no clinically important difference in deaths between using Korotkoff phase IV and Korotkoff phase V to represent diastolic BP (none in either arm).

Stillbirth

No evidence was identified to inform this outcome.

Neonatal death

No evidence was identified to inform this outcome.

Perinatal mortality

- Low quality evidence from 1 RCT (N=220) showed no clinically important difference in perinatal mortality between using Korotkoff phase IV and Korotkoff phase V to represent diastolic BP: RR 1.14 (95% CI 0.16 to 7.92).

Preterm birth

No evidence was identified to inform this outcome.

Important outcomes

Pre-eclampsia

- Low quality evidence from 1 RCT (N=220) showed no clinically important difference in pre-eclampsia between using Korotkoff phase IV and Korotkoff phase V to represent diastolic BP: RR 1.16 (95% CI 0.89 to 1.49).

Number of maternal antenatal hospital admissions

No evidence was identified to inform this outcome.

Maternal admission to intensive care

No evidence was identified to inform this outcome.

Induction of labour

No evidence was identified to inform this outcome.

Neonatal unit admission

No evidence was identified to inform this outcome.

Neonatal unit length of stay

No evidence was identified to inform this outcome.

Neonatal endotracheal intubation and use of mechanical ventilation

No evidence was identified to inform this outcome.

Comparison 3. Semi-automated BP monitor and education package (CRADLE intervention) versus usual care

Critical outcomes

Systolic BP ≥150 mmHg

No evidence was identified to inform this outcome.

Maternal death

- Low quality evidence from 1 RCT (N=536,233) showed no clinically important difference in deaths between the CRADLE package and usual care: RR 0.80 (95% CI 0.30 to 2.11).

Stillbirth

No evidence was identified to inform this outcome.

Neonatal death

No evidence was identified to inform this outcome.

Perinatal mortality

No evidence was identified to inform this outcome.

Preterm birth

No evidence was identified to inform this outcome.

Important outcomes

Pre-eclampsia

No evidence was identified to inform this outcome.

Number of maternal antenatal hospital admissions

No evidence was identified to inform this outcome.

Maternal admission to intensive care

No evidence was identified to inform this outcome.

Induction of labour

No evidence was identified to inform this outcome.

Neonatal unit admission

No evidence was identified to inform this outcome.

Neonatal unit length of stay

No evidence was identified to inform this outcome.

Neonatal endotracheal intubation and use of mechanical ventilation

No evidence was identified to inform this outcome.

Outcomes reported, showing no difference but not assessed with GRADE

Eclampsia, cerebrovascular event, operative delivery

Economic evidence statements

No economic evidence was identified which was applicable to this review question.

The committee's discussion of the evidence

Interpreting the evidence

The outcomes that matter most

The Cochrane protocol's primary outcome was a systolic BP greater than or equal to 150mmHg, in addition to this the committee agreed that the critical outcomes were maternal death, perinatal death and preterm birth as these are the most impactful possible consequences of poorly managed hypertension during pregnancy. All other outcomes listed in the Cochrane protocol (maternal morbidities, maternal quality of life, maternal and neonatal use of health service resources) were agreed to be important outcomes by the committee.

The quality of the evidence

There was no evidence available for the majority of comparisons that the committee were interested in. For the comparisons where there was evidence that the Cochrane team applied GRADE to, it was low quality and downgraded typically due to imprecision (small sample size and the 95% confidence intervals spanned possible benefit and possible harm) and in the case of the CRADLE trial due to indirectness. The study of the CRADLE device may only have limited applicability to UK recommendations. The device was compared with standard care and the standard care in the mostly low-income countries that the study took place in, may have varied from site to site and be significantly different from the UK. For the outcomes that were included in GRADE tables in the Cochrane review but not given formal GRADE ratings (due to zero events occurring in either arm), the committee considered the evidence to be of very low quality in terms of the certainty of effect due to the likely underpowering of the studies to detect an effect..

The committee noted that many studies were excluded from the Cochrane review due to the paucity of devices that are validated for use in pregnancy. They agreed this was appropriate as it is important that devices are validated in the specific population, they were aware that devices previously validated in the general population have been shown to be inaccurate in pregnant women.

Benefits and harms

There was no evidence of any important difference for any outcome in the 3 comparisons. The recommendations were therefore based predominantly on the committee's knowledge and experience. In the absence of evidence to justify deviations, the committee were also keen to make recommendations consistent with existing NICE guidance on hypertension in pregnancy.

In the committee's experience and in line with the NICE guideline on hypertension in adults, using a device that is validated for use in pregnancy, has the correct cuff size for the woman and is only used once a woman has had time to settle down and relax will have benefits in terms of increasing the accuracy of testing and reducing false positive and negatives. The British and Irish Hypertension Society lists the devices validated for pregnancy on their website and the committee agreed this is a useful resource.

Monitoring of blood pressure at every routine antenatal visit enables early identification and management of hypertension and pre-eclampsia which can have severe consequences if not diagnosed and managed. While it does involve a small burden and demands for time within appointments, the committee agreed this was an appropriate trade-off and represents current practice.

The committee agreed it was important to differentiate between women with hypertension under 20+0 weeks and over 20+0 weeks. Gestational hypertension only occurs after 20+0 weeks and therefore any hypertension detected under 20+0 weeks is likely to be pre-existing chronic hypertension.

The NICE guideline on hypertension in pregnancy uses a sustained blood pressure of 140/90 mmHg as a threshold for hypertension and for initiating treatment in secondary care and 135/85 mmHg as a target blood pressure when on antihypertensive treatment, therefore the committee used similar thresholds to guide the early identification and assessment recommendations they made.

In line with the definition of severe hypertension as blood pressure of 160/110 mmHg or over in the NICE guideline on hypertension in pregnancy, the committee agreed that women with severe hypertension (160/110 mmHg or higher) or signs and symptoms of pre-eclampsia will need immediate assessment in secondary care and treatment to reduce the risk of adverse clinical outcomes. However, women with milder hypertension (140/90 mmHg to 159/109 mmHg) and no signs or symptoms of pre-eclampsia may not need treatment, as it is possible the finding was spurious or the pressure may return to normal spontaneously. Therefore, the committee agreed in order to avoid overtreatment and diagnosis for women meeting these criteria, timely assessment in secondary care within 24 hours is appropriate. The assessment would need to be by someone with appropriate skills and training to consider whether treatment was required, typically this would be a specialist midwife or obstetrician. The committee specified the 24 hour timeframe based on their experience. While this will create additional burden for the healthcare system and the woman (including likely a repeat visit to some healthcare site), the committee agreed it was important to recommend a timeframe as a balance between avoiding overtreatment and preventing undiagnosed hypertension from being missed. The committee also cross-referred to the recommendations on diagnosing hypertension in the NICE guideline on hypertension in adults as they include other steps that may avoid overtreatment or diagnosis (for example recording multiple times in case of an elevated reading and recording only the lowest reading to avoid nervousness impacting results).

Cost effectiveness and resource use

A systematic review of the economic literature was conducted but no relevant studies were identified which were applicable to this review question.

The recommendations made by the committee are in accordance with current NICE guidance and will reinforce best practice. Therefore, no resource impact is expected. It was noted that there is a wide variation in the types of device used by trusts in the UK. Consequently, there may be wide variation in the cost of different devices and thought it was important this was a consideration for purchasers within trusts. The committee highlighted though it was important to specify that medical professionals should use a device that is validated for use in pregnancy as this would lead to a more accurate diagnosis and thereby improved health outcomes. If consideration is given to these things there may be a modest decrease in costs and improvement in pregnancy outcomes from these recommendations.

References

Ashworth 2020

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Brown MA, Buddle ML, Farrell T, Davis G, Jones M. Randomised trial of management of hypertensive pregnancies by Korotkoff phase IV or phase V. Lancet 1998;352(9130):777-81.

Pealing 2019

Pealing L, Crawford C, Wilson H, Tucker K, MacKillop L, Churchill D, et al. Self-monitoring blood pressure in hypertensive pregnancies: the optimum-BP pilot randomised controlled trial. BJOG 2019;126(6):e139.

Vousden 2019

Vousden N, Lawley E, Nathan HL, Seed PT, Gidiri MF, Goudar S, et al, CRADLE Trial Collaborative Group. Effect of a novel vital sign device on maternal mortality and morbidity in low-resource settings: a pragmatic, stepped-wedge, cluster-randomised controlled trial. *Lancet Global Health* 2019;7(3):e347-56.

Appendices

Appendix A – Review protocol

Review protocol for review question: what is the most effective way of measuring blood pressure (including setting and technique) using validated equipment to identify a hypertensive disorder of pregnancy?

See Cochrane review: https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD012739.pub2/full

Appendix B – Literature search strategies

Literature search strategies for review question: what is the most effective way of measuring blood pressure (including setting and technique) using validated equipment to identify a hypertensive disorder of pregnancy?

See Cochrane review:
https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD012739.pub2/full

Appendix C – Clinical evidence study selection

Study selection for: what is the most effective way of measuring blood pressure (including setting and technique) using validated equipment to identify a hypertensive disorder of pregnancy?

See Cochrane review:
https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD012739.pub2/full

Appendix D – Clinical evidence tables

Evidence tables for review question: what is the most effective way of measuring blood pressure (including setting and technique) using validated equipment to identify a hypertensive disorder of pregnancy?

See Cochrane review: https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD012739.pub2/full

Appendix E – Forest plots

Forest plots for review question: what is the most effective way of measuring blood pressure (including setting and technique) using validated equipment to identify a hypertensive disorder of pregnancy?

See Cochrane review:
https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD012739.pub2/full

Appendix F – GRADE tables

GRADE tables for review question: what is the most effective way of measuring blood pressure (including setting and technique) using validated equipment to identify a hypertensive disorder of pregnancy?

See Cochrane review: https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD012739.pub2/full

Appendix G – Economic evidence study selection

Economic evidence study selection for review question: What is the most effective way of measuring blood pressure (including setting and technique) using validated equipment to identify a hypertensive disorder of pregnancy?

A single economic search was undertaken for all topics included in the scope of this guideline. No economic studies were identified which were applicable to this review question. See supplementary material 2 for details.

No economic evidence was identified which was applicable to this review question.

Appendix H – Economic evidence tables

Economic evidence tables for review question: What is the most effective way of measuring blood pressure (including setting and technique) using validated equipment to identify a hypertensive disorder of pregnancy?

No economic evidence was identified which was applicable to this review question.

Appendix I – Economic evidence profiles

Economic evidence profiles for review question: What is the most effective way of measuring blood pressure (including setting and technique) using validated equipment to identify a hypertensive disorder of pregnancy?

No economic evidence was identified which was applicable to this review question.

Appendix J – Economic analysis

Economic analysis for review question: What is the most effective way of measuring blood pressure (including setting and technique) using validated equipment to identify a hypertensive disorder of pregnancy?

No economic analysis was conducted for this review question.

Appendix K – Excluded studies

Excluded studies for review question: what is the most effective way of measuring blood pressure (including setting and technique) using validated equipment to identify a hypertensive disorder of pregnancy?

See Cochrane review:
https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD012739.pub2/full

Economic studies

A single economic search was undertaken for all topics included in the scope of this guideline. No economic studies were identified which were applicable to this review question. See supplementary material 2 for details.

Appendix L – Research recommendations

Research recommendations for review question: what is the most effective way of measuring blood pressure (including setting and technique) using validated equipment to identify a hypertensive disorder of pregnancy?

No research recommendations were made for this review question.