

# CARDIOVASCULAR DISEASES (CVD) IN PREGNANCY

A Scoping Review of  
Guidelines and Policies  
with a Focus on Low-and  
Middle-Income Countries

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# Abbreviations

<b>ABPM</b>	Ambulatory blood pressure monitoring	<b>MI</b>	Myocardial infarction
<b>ACE-I</b>	Angiotensin-converting enzyme inhibitor	<b>MRI</b>	Magnetic resonance imaging
<b>ACS</b>	Acute coronary syndrome	<b>mWHO</b>	Modified World Health Organization
<b>AF</b>	Atrial fibrillation	<b>NYHA</b>	New York Heart Association
<b>AHF</b>	Acute heart failure	<b>PAPP-A</b>	Pregnancy-associated plasma protein-A
<b>AMI</b>	Acute myocardial infarction	<b>PIGF</b>	Placental Growth Factor
<b>ARB</b>	Angiotensin receptor blocker	<b>PPCM</b>	Peripartum cardiomyopathy
<b>ARNI</b>	Angiotensin receptor neprilysin inhibitor	<b>SBP</b>	Systolic blood pressure
<b>BMI</b>	Body mass index	<b>SLCOG</b>	Sri Lanka College of Obstetricians and Gynaecologists
<b>BP</b>	Blood pressure	<b>SOGP</b>	Society of Obstetricians and Gynaecologists Pakistan (SOGP)
<b>CAD</b>	Coronary artery disease	<b>VTE</b>	Venous thromboembolism
<b>CCB</b>	Calcium channel blocker	<b>WHO</b>	World Health Organization
<b>CO</b>	Cardiac output		
<b>CT</b>	Computed tomography		
<b>CVD</b>	Cardiovascular disease		
<b>CCU</b>	Critical Care Unit		
<b>DBP</b>	Diastolic blood pressure		
<b>ECG</b>	Electrocardiogram		
<b>EF</b>	Ejection fraction		
<b>ESC</b>	European Society of Cardiology		
<b>FIGO</b>	International Federation of Gynecology and Obstetrics		
<b>HDP</b>	Hypertensive disorders of pregnancy		
<b>HDU</b>	High Dependency Unit		
<b>HELLP</b>	Hemolysis, Elevated Liver enzymes, Low Platelet Count		
<b>HF</b>	Heart failure		
<b>ICU</b>	Intensive care unit		
<b>IE</b>	Infective endocarditis		
<b>ISSHP</b>	International Society for Study of Hypertensive Disorders of Pregnancy		
<b>IV</b>	Intravenous		
<b>LMIC</b>	Low Middle-Income Countries		
<b>LMWH</b>	Low molecular weight heparin		
<b>LVEF</b>	Left ventricular ejection fraction		
<b>MAP</b>	Mean Arterial Pressure		

# Glossary

**Angiography:** An X-ray examination of the blood vessels or chambers of the heart. It is done by tracing the course of a special fluid (called contrast or dye) that has been injected into the bloodstream. The X-ray pictures are called angiograms.

**Angiotensin:** Converting Enzyme Inhibitors (ACE inhibitors): A group of drugs used to treat high blood pressure and heart failure. ACE inhibitors block a specific enzyme (ACE or angiotensin-converting enzyme) that retains salt in the kidney and can cause heart and blood pressure problems. ACE inhibitors have been shown to decrease the risk of dying from a heart attack and to improve heart function.

**Angiotensin II Receptor Blockers (ARBs):** A group of drugs used to treat high blood pressure.

**Antibiotics:** A medicine, which may be taken by mouth as a syrup, tablet, or capsule, or may be given through a drip into a vein, to prevent or treat a bacterial infection.

**Anticoagulant:** A drug used to reduce blood clotting, e.g. warfarin, aspirin

**Antihypertensive:** Any drug or other therapy that lowers blood pressure.

**Aortic Disease:** A disease of the Aorta (The main artery that takes blood from the heart into the circulation around the body (systemic circulation))

**Arrhythmia:** A disturbance in the normal heart rhythm

**Beta-blocker:** An antihypertensive medicine that limits the activity of epinephrine, a hormone that increases blood pressure.

**Calcium channel blocker (or calcium blocker):**

A medicine that lowers blood pressure by regulating calcium-related electrical activity in the heart.

**Cardiac:** A term for anything to do with the heart (e.g. cardiac muscle, cardiac specialist, cardiac rhythm, etc.).

**Cardiomyopathy:** Damaged or diseased heart muscle.

**Cardiopulmonary Bypass:** The process by which a machine is used to do the work of the heart and lungs so the heart can be stopped during surgery.

**Cardiovascular:** About the heart and blood vessels.

**Coarctation:** An area of stenosis (narrowing) in an artery (usually the aorta)

**Coronary Arteries:** These small arteries carry the blood supply to the heart muscle itself, and are the first arteries to branch off the aorta

**Coronary Heart Disease:** Disease of the coronary arteries usually in adults

**Congenital Heart Disease:** A defect or disease affecting the heart from birth

**Congestive Heart Failure:** A condition that occurs when there is a build-up of fluid (i.e. congestion) in the lungs or other organs such as the liver

**Diastolic blood pressure:** The lowest blood pressure measured in the arteries. It occurs when the heart muscle is relaxed between beats

**Diuretics:** Medicine to help the body get rid of the excess fluid that may build up in the lungs or elsewhere in the body in congestive heart failure, e.g. Aldactone, Lasix

**Doppler ultrasound:** A technology that uses sound waves to assess blood flow within the heart and blood vessels and to identify leaking valves

**Echocardiogram (Echo):** An ultrasound scan of the heart. Very high-frequency sound waves (ultrasound) are used to create a moving picture of the heart and blood flowing through it, using a sophisticated computer. This test detects most heart defects and can provide detailed information about the nature and severity of heart problems of many kinds.

**Eclampsia:** Eclampsia is a result of unchecked preeclampsia. High blood pressure continues to rise, damaging the woman's bodily organs, and reducing blood flow to the placenta. Convulsions (seizures) appear as labor approaches and continue through labor and delivery. This condition puts the mother and her fetus in a life-threatening situation.

**Edema:** Abnormal fluid accumulation in body tissues.

**Electrocardiogram (ECG):** A test to measure the heart's electrical activity with each heartbeat. Wires are attached to the skin of the arms, legs, and chest, using soft, stick-on discs (called 'electrodes'). A tracing is printed on paper and gives information about the heart rate and regularity, as well as providing data about the enlargement of the heart chambers and thickening of the heart muscle, which may provide useful information about the nature and severity of heart problems.

**Embolus:** Also called embolism; a blood clot that forms in a blood vessel in one part of the body and travels to another part.

**Endocarditis:** An infection of the endocardium, which occurs as Acute (rapid onset) or Sub acute (more gradual onset) Infective Endocarditis. Such infections are much more likely to develop in patients with existing abnormalities of heart valves or other cardiac defects (e.g. VSD or PDA) than in people with entirely healthy



hearts, who are regarded as being “at risk”, though they occasionally occur in individuals with no pre-existing heart problem.

**Gestational Hypertension:** High blood pressure that is diagnosed after 20 weeks of pregnancy.

**Haemoglobin:** The red blood pigment that carries oxygen in the red blood cells

**Holter monitoring:** A technique for the continuous recording of electrocardiographic (ECG) signals, usually over 24 hours, to detect and diagnose ECG changes. (Also called ambulatory monitoring.)

**Hypotension:** Low blood pressure (in the systemic circulation) is a problem quite often encountered after heart surgery and may need treatment with medications to raise the blood pressure.

**Hypertension:** High blood pressure. The term usually refers to high pressure in the systemic circulation. However, ‘pulmonary hypertension’ means elevation of pressure in the lung circulation.

**Hypertensive Emergency:** a severe elevation in blood pressure that can lead to organ damage, including encephalopathy (brain damage), heart attack, heart failure, hemorrhagic stroke (bleeding into the brain), eclampsia (a condition in which pregnant women have water retention, high blood pressure, protein in the urine, and seizures), kidney damage, and arterial bleeding.

**Hypertrophy:** Thickening or enlargement of a structure. (Left ventricular hypertrophy means thickening of the wall of the left ventricle)

**Interventional Procedures:** Procedures of this type may be used to stretch open a narrow valve or blood vessel, using a catheter with an inflatable balloon.

**Intravenous Drip (IV or Drip):** A method of providing medications, fluids or nutrition into a vein. The fluid usually flows from a polythene bag or bottle and can be seen to ‘drip’ into a small container (chamber), which is connected by a tube to a cannula in the vein.

**Murmur:** A noise, heard with the doctor’s stethoscope (or occasionally with the naked ear), which results from turbulence (eddies) in the flow of blood through the heart or blood vessels. The noise often has a ‘blowing’, ‘swishing’ or ‘cooing’ character and is quite different from the ‘heart sounds’

**Myocarditis:** Inflammation of the heart muscle caused by a virus or other illness.

**Myocardial infarction:** Death of a portion of the heart muscle tissue due to a blockage or interruption in the supply of blood to the heart muscle.

**Myocardium:** The cardiac muscle.

**Preeclampsia:** A disorder that can occur during

pregnancy or after childbirth in which there is high blood pressure and other signs of organ injury. These signs include an abnormal amount of protein in the urine, a low number of platelets, abnormal kidney or liver function, pain in the upper abdomen, fluid in the lungs, or a severe headache or vision changes.

**Prenatal Care:** A program of care for a pregnant woman before the birth of her baby.

**Preterm:** Less than 37 weeks of pregnancy

**Pulmonary Arteries:** The arteries carry blood into each lung. There are two large branches from the (main) pulmonary artery, (‘left pulmonary artery’ and ‘right pulmonary artery’) and many smaller branches within each lung. All these are called ‘pulmonary arteries’.

**Pulmonary Artery:** The main artery carrying blood from the heart to the lungs.

**Stenosis:** The narrowing or constriction of an opening (such as a heart valve).

**Stroke:** A sudden disruption of blood flow to the brain, either by a clot or a leak in a blood vessel.

**Systolic Blood Pressure:** Pressure inside the arteries when the heart contracts with each beat.

**Tachycardia:** A fast heart rate.

**Thrombolysis:** The breaking up of a blood clot

**Thrombosis:** A blood clot that forms inside the blood vessel or cavity of the heart.

**Transposition:** This is a term used to mean that two structures (usually the aorta and pulmonary artery) are in the opposite position to normal such as in ‘Transposition of the Great Arteries’ (TGA)

**Valve:** A structure in a blood vessel or the heart that ensures blood flows only one way. They are constructed of single or multiple flaps which swing open to allow blood to flow forwards and swing shut to prevent back flow. The valve flaps are referred to as ‘leaflets’ or ‘cusps’

**Veins:** Blood vessels that carry blood back towards the heart, after it has circulated the body. Veins usually carry deoxygenated blood, except in the pulmonary veins where oxygenated blood is carried back to the heart from the lungs

**Ventricular Septal Defect (VSD):** A defect (hole) in the ventricular septum that allows blood to shunt from one ventricle to the other

**X-ray:** An X-ray of the chest will often be performed as part of an initial assessment or a follow-up appointment. This will show the size and shape of the heart and also help to demonstrate the effects of heart problems on the lungs (e.g. congestion of the lungs). Enlargement of the heart and abnormalities of its shape may give valuable information about many heart defects and their severity.

# Executive Summary

## Introduction

Cardiovascular diseases (CVD) account for over one third of pregnancy-related maternal deaths globally and are considered the single largest cause of indirect maternal mortality. While the majority of preventable maternal deaths happen in low-middle income countries (LMICs), the prevalence and impact of CVDs during pregnancy is poorly documented in most countries. Most deaths in women with cardiac disease in pregnancy can be prevented if early detection and careful follow-up are part of routine pregnancy care. We conducted a scoping review to identify and map the clinical guidelines and policies on CVD in pregnancy for women in LMICs.

## Research Questions

- i) What clinical guidelines and policies have been developed to address the cardiovascular needs of pregnant women in LMICs?
- ii) Where are the gaps in coverage, what is the timing of their recommendations, and what are the key clinical conditions?

## Methods

The review followed the Joanna Briggs Institute (JBI) methodology for scoping reviews. Clinical guidelines and policies on CVD in pregnancy were searched. A search of key electronic databases of PubMed, EMBASE, CINAHL, The GIN international guideline library (EBSCO) and Google Scholar, along with individual websites of national and international professional organizations and associations, and Ministry of Health of Low- and Middle-Income Countries (LMIC) was conducted. Inclusion was based on clinical conditions including hypertensive Diseases of Pregnancy (HDP), primary cardiac conditions and stroke and cerebrovascular conditions with a focus on LMICs. Guidelines extracted were from the World Health Organization (WHO), international professional organizations, national professional organizations, and Ministry of Health in LMICs, and were published between 2011 and 2023. Selected guidelines were reviewed and shortlisted documents were extracted and analyzed.

## Results

A total of 17 clinical guidelines were included in the review. Seven were from the WHO, three were from International Professional Organizations (IPO), three were from the Ministry of Health (MoH) and four were from National Professional Organizations (NPO). No specific policies on CVD in pregnancy were found. Three guidelines addressed CVD care in pregnancy comprehensively, while 14 guidelines focused only on hypertensive disorders of pregnancy (HDP). Out of the 14 HDP guidelines, four focused on the prevention and screening of preeclampsia, while two focused on its management. No guideline was found addressing the care of women who experience stroke in pregnancy. There were several inconsistencies among the clinical recommendations and a lack of recommendations on specific aspects of CVD care. None of the guidelines addressed health system requirements to deliver quality CVD care in pregnancy. We recommend addressing gaps in leadership and governance, health workforce, access to medications and service delivery through investment, multistakeholder collaboration and advocacy.

## Conclusion

Evidence-based and comprehensive CVD care in pregnancy is crucial for reducing maternal morbidity and mortality. This review identified 17 guidelines for managing CVD in pregnancy in low-middle-income countries (LMICs). We highlight the need to address gaps in terms of availability and access to policies and guidelines on CVD in LMICs, along with the need for concerted efforts to ensure standardized and comprehensive care for CVD in pregnancy.



# 1. Introduction

Cardiovascular diseases (CVD) account for over 33% of pregnancy-related maternal deaths and are considered the single largest cause of indirect maternal mortality (1, 2). Some cardiac diseases may be pre-existing conditions, i.e. conditions that the woman had prior to pregnancy, or they may develop for the first time during pregnancy. Pre-existing conditions that can make pregnant women vulnerable to CVD include hypertension, diabetes, and congenital heart disease (3). Pre-existing CVD is a significant cause of maternal morbidity and mortality and has been cited to affect between 1% and 4% (4) of all pregnancies. Among the pregnant women with pre-existing cardiac disease, 16% develop cardiac complications such as arrhythmia and heart failure during the course of pregnancy (5).

## *CVD during pregnancy in the global south*

The World Health Organization (WHO) estimates that over 95% of maternal deaths happen in developing nations, the majority of which are preventable (6). Analyses of the maternal mortality data show that over one-fourth of the global mortality during pregnancy is caused by indirect causes, of which heart diseases and hypertension contribute the highest burden (2).

Cardiovascular conditions disproportionately affect women from or living in low-income countries and **people of color living across settings**. Women living in southern Asia and sub-Saharan Africa have the highest CVD burden, specifically hypertensive heart disease (7, 8). For example, a study reported that cardiac disease is the second leading cause of maternal deaths in Sri Lanka, which is attributed to around one-fifth of the total maternal deaths over the past 15 years (9). Lumsden et al (10) reported that among pregnant women in Kenya, maternal deaths due to CVD were 10 times more than maternal mortality due to all causes. It is estimated that while hypertensive disorders of pregnancy (HDP) affect between 2–8% of pregnancies globally, around one - fourth (25) of maternal deaths in Latin America and one - tenth (10%) in Asia and Africa are due to HDP (11). The true prevalence of cardiac disease in pregnant women is yet to be established. It is also unknown whether there is an increased frequency for women in developed countries compared versus low and middle-income countries. What is known is that most pregnancies with cardiac disease can be safely managed if early detection and careful follow-up are part of routine pregnancy and postnatal care.

Given this understanding, we conducted a scoping review to identify and map the clinical guidelines and policies on CVD in pregnancy. The review, with the following research questions, focused on low- and middle-income countries (LMICs).

1. What clinical guidelines and policies exist from the World Health Organization, international professional organizations, national professional organizations, and the Ministry of Health in low- and middle income countries to address the cardiovascular needs of pregnant women?
2. Where are the gaps concerning the objective of the guidelines or policies (prevention, screening, or management), timing (interventions aimed before, during, or after pregnancy), and key clinical conditions?

## 2. Methodology

*The review was conducted as per the Joanna Briggs Institute (JBI) methodology for scoping reviews (12) based on an a priori protocol.*

### 2.1. Eligibility Criteria:

#### Inclusion

Clinical guidelines and policies on CVD in pregnancy published by the World Health Organization (WHO), International Professional Organizations, National Professional Organizations, and the Ministry of Health (MOH) in LMICs were included. The international professional organizations include associations, societies, or organizations of professionals with international presence, such as the International Federation of Gynecology and Obstetrics (FIGO), the International Society for the Study of Hypertension (ISSHP), and the European Society of Cardiology (ESC), to reach both high-income country (HIC) and low-middle income country (LMIC) populations. The national professional organizations include associations, societies, or organizations of professionals operating within the LMICs. We referred to the World Bank's definition to select LMICs (13), categorized at the time of the search.

#### • CVD conditions in scope included

1. The hypertensive disorders of pregnancy (gestational hypertension, essential hypertension, preeclampsia, HELLP (hemolysis, elevated liver enzymes, low platelet count) syndrome, and eclampsia)
2. Primary cardiac conditions such as congenital and acquired heart diseases in pregnancy (Valvular heart diseases, arrhythmias, cardiomyopathies, ischemic heart disease), and
3. Stroke and cerebrovascular diseases.

• **Language:** Clinical guidelines and policies in English, Spanish, Arabic, and Chinese languages were included. Guidelines in Spanish and Chinese were translated into English language with the help of translators and Google Translate.

• **Year of publication:** The review was limited to documents published between 2011 and 2023 to be reflective of current clinical practice.

#### Exclusion

- Primary research such as clinical trials, cohort studies, case-control studies, and conference abstracts with no specific policy recommendations were excluded. Conditions other than those specifically mentioned in the inclusion criteria, such as blood disorders, thrombotic disorders, etc., were excluded.

### 2.2. Information Sources:

Databases of MEDLINE-PubMed, Scopus, Google Scholar, the GIN international guideline library (EBSCO) along with individual websites of national and international professional organisations and associations, and Ministry of Health of Low- and Middle-Income countries were searched.

### 2.3. Search Strategy:

The search strategy aimed to locate both government and non-government clinical guidelines and policies around CVD in pregnancy. An initial limited search of MEDLINE and Google scholar was undertaken to identify journal articles on the topic. The text words contained in the titles and abstracts of relevant articles and the index terms used to describe the articles were used to develop a full search strategy for databases. The search strategy, including all identified keywords and index terms, was adapted for each included database and/or information source. The search strategy adopted for the database search is given in Annexure 1.

The reference lists of all included sources of evidence were screened for additional documents. The focus of the scoping review was on LMIC; however not many documents from LMIC were identified from the database search of published articles. Therefore, a separate search for relevant guidelines and policies was done by accessing relevant ministry websites, country-specific professional organizations, and NGOs of each low- and middle-income country listed on the World Bank website. Online searches were carried out by accessing the websites of international and national organizations, specialist societies of obstetrics and gynaecology and cardiovascular diseases from LMICs, medical associations, and other relevant groups such as the International Federation of Gynaecology and Obstetrics (FIGO), The World Health Organization (WHO), The African Federation of Obstetrics and Gynaecology (AFOG), Asia and Oceania Federation of Obstetrics

& Gynaecology (AOFOG), Latin American Federation of Obstetrics and Gynaecology Societies (FLASOG), European Society of Cardiology, The World Hypertension League, International Society of Hypertension, European Society of Hypertension and JHPIEGO.

## 2.4. Selection of Guidelines and Policies:

Following the search, all identified citations and guidelines were collated and uploaded into a reference management software, and duplicates were removed. Titles and abstracts fitting the study description were extracted by one team member. The clinical guidelines and policies not meeting the inclusion criteria were excluded. After the preliminary screening of abstracts, full-text papers of shortlisted guidelines and policies were reviewed by a team member for relevance. If more than one guideline or policy was available from the same organization, the latest updated version was included. Reasons for exclusion are reported in the flowchart (Fig.1). If the guideline or policy included in the review referred to an older version while discussing recommendations, we have also included the specific content of the recommendation from that guideline.

## 2.5. Data Extraction Process:

Clinical guidelines and policies were first summarised. Data from the included guidelines and policies were extracted using a data extraction form in MS Excel designed for this study [Annexure.2]. Data items extracted include the title of the guideline/policy, year and type of publication, publishing entity, country of origin, target audience, target population, target clinical conditions, timing of recommendations, summary of recommendations, etc. The data was extracted by one researcher and checked for accuracy by another researcher.

## 2.6. Synthesis of Results:

Clinical guidelines and policies were grouped in terms of geographic location and publisher (WHO, international professional organizations, Ministry of Health, and national professional organizations). Further, an attempt to understand the gaps in recommendations among the guidelines was made by comparing the specific recommendations (concerning the aims of recommendations and stages of pregnancy).

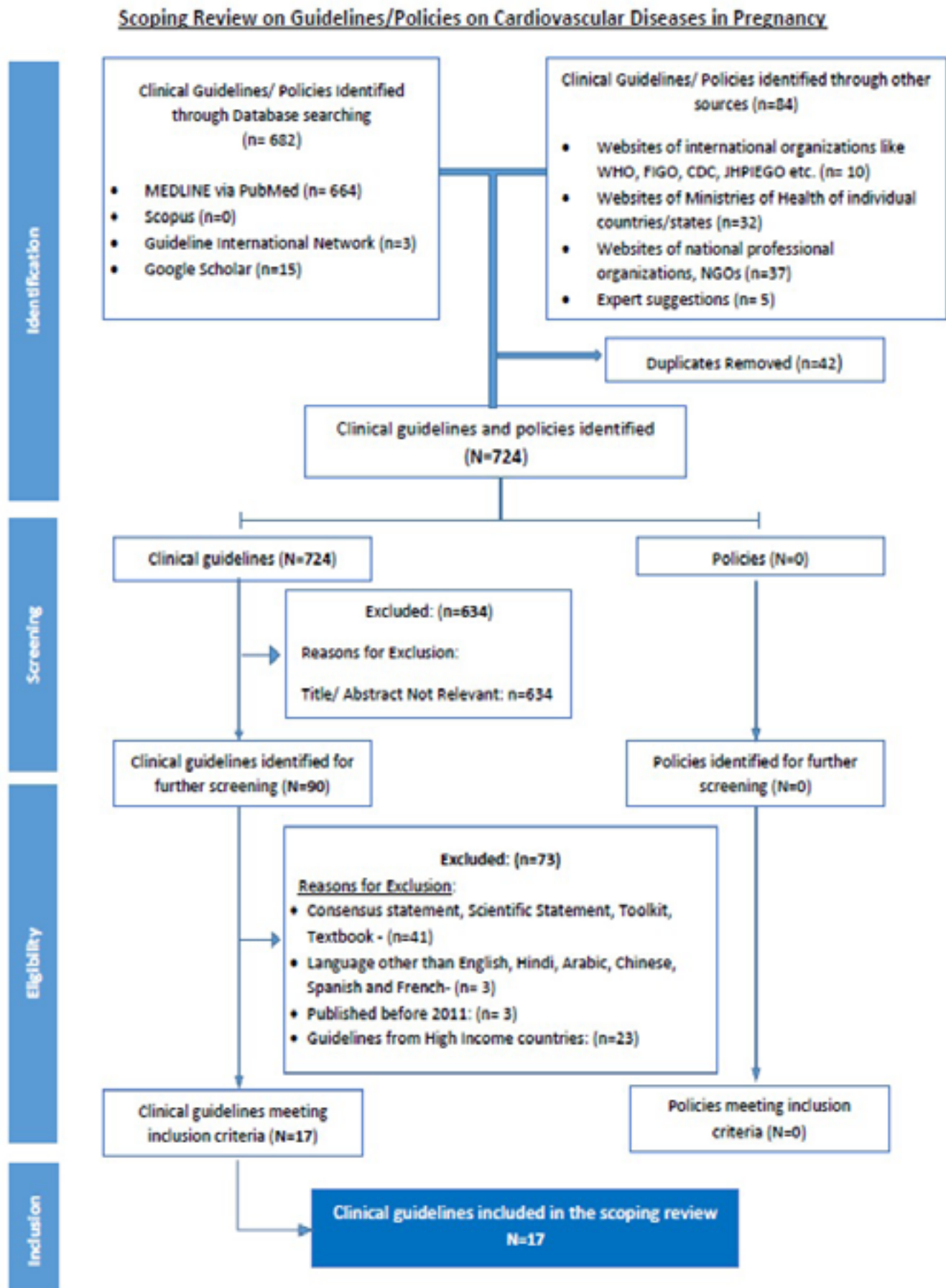
# 3. Results

## 3.1. Guidelines Selected for Review:

The search identified 766 documents with keywords in the titles and abstracts, which were a mix of research studies, reviews, scientific statements, toolkits, and textbooks. Out of these, 682 documents were obtained through online database searching, and 84 documents were identified through searches of individual websites and expert suggestions. Two guidelines from the Middle East and one guideline from China were accessed with the help of researchers who are native speakers of the languages. Six documents in Spanish that included guidelines and consensus statements were shared by an expert and translated with the help of Google Translate. After the final screening, 90 clinical guidelines were considered for inclusion in the review, and 17 guidelines were selected. No separate policies on CVD in pregnancy were identified. The clinical guidelines and policy selection process has been summarized in the flow diagram in Figure 1.

From the selected 17 clinical guidelines, 7 were from the WHO, three were from International Professional Organizations (IPO), three were from the Ministry of Health (MOH) and four were from National Professional Organizations (NPO).

Fig. 1. Flow Chart of literature search, screening and selection of documents for the scoping review, modified from PRISMA (1)



### Guidelines on CVD in Pregnancy:

The guidelines included in the review are based on different aspects of cardiovascular care during pregnancy. Fourteen guidelines focused on hypertensive disorders of pregnancy (HDP). Two of these HDP guidelines were specifically aimed at the management of pre-eclampsia and four guidelines on prevention and screening pre-eclampsia. The remaining eight guidelines on HDP covered aspects of prevention, screening, and management of HDP, including pre-eclampsia. Three guidelines covered the comprehensive care of cardiac diseases in pregnancy, such as aortic diseases, arrhythmia, cardiomyopathy, congenital heart diseases, coronary artery diseases, heart failure, hypertensive disorders of pregnancy, pulmonary hypertension, and valvular heart diseases. Table 3.1 presents the type of guidelines on CVD in pregnancy.

The majority (7 out of 17) of the guidelines were published by the World Health Organization, and three guidelines were published by international professional organizations. The Ministry of Health (MOH) in Malaysia, Peru, and South Africa published one guideline each. The remaining four guidelines were published by national professional organizations of Brazil, China, Pakistan, and Sri Lanka. Figure.3.1. presents a graphical representation of the types of guidelines on CVD in pregnancy.

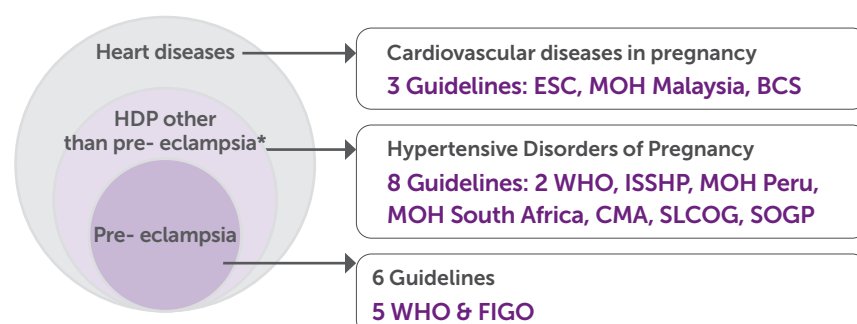
**Table.3.1. Types of CVD in pregnancy addressed by guidelines.**

Category	Guidelines**	Number of guidelines by publisher				Total number of guidelines
		WHO	IPO	MOH	NPO	
Hypertensive Disorders of Pregnancy (HDP)	Screening / prevention of pre-eclampsia in pregnancy	3	1	0	0	4
	Management of pre-eclampsia in pregnancy	2	0	0	0	2
	Screening, prevention and management of Hypertensive Disorders of Pregnancy (HDP)	2	1	2	3	8
Heart disease in pregnancy	Diagnosis, prevention and management of Cardiac diseases during pregnancy	-	1	1	1	3
Total		7	3	3	4	17

WHO- World Health Organization, IPO- International professional organization, MOH- Ministry of Health, NP- National professional organization

\*\* Refer Annexure [2] for a list of guidelines by year of publication and CVD conditions targeting pregnant women and health providers

**Fig.3.1. Representation of guidelines on CVD in pregnancy included in the review:**



\* HDP other than pre-eclampsia: chronic hypertension, gestational hypertension, and white-coat hypertension

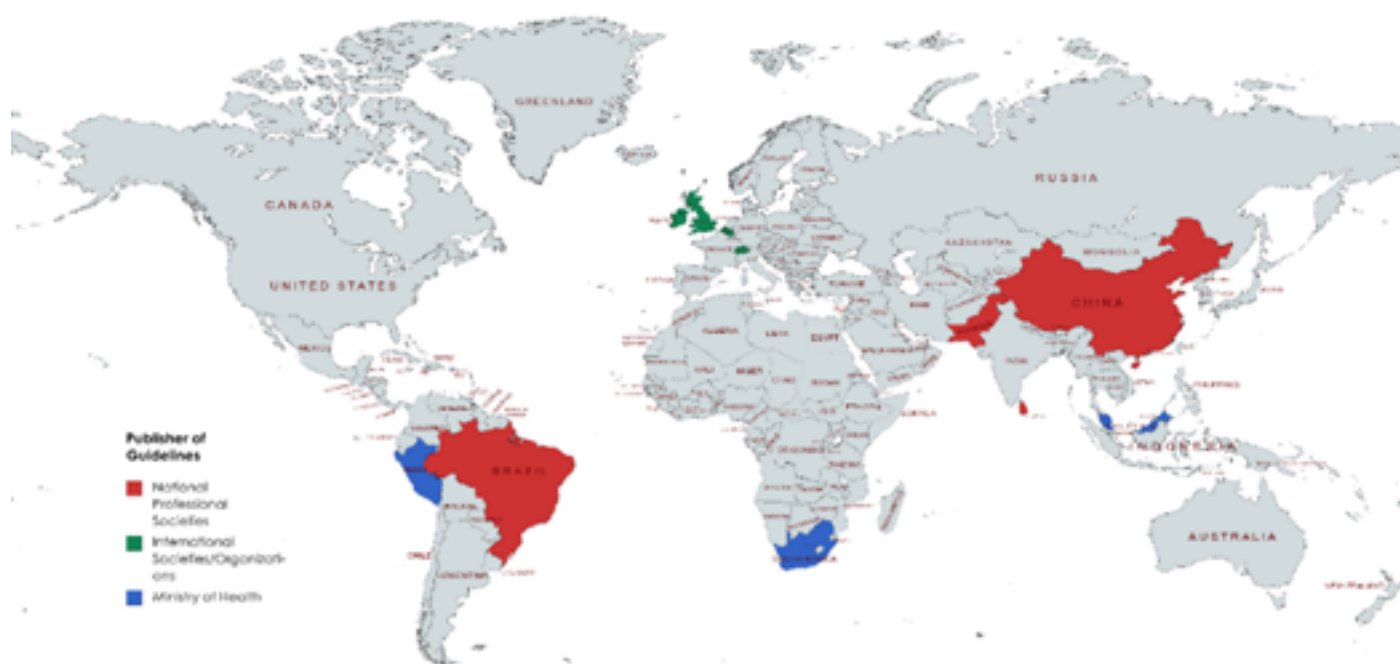
(WHO- World Health Organization, ESC- European Society of Cardiology, FIGO- The International Federation of Gynecology and Obstetrics, ISSHP- International Society for the Study of Hypertension in Pregnancy, MOH- Ministry of Health, BCS- Brazilian Cardiology Society, CMA- Chinese Medical Association, SLCOG- Sri Lanka College of Obstetricians and Gynaecologists, SOGP- Society of Obstetricians and Gynaecologists Pakistan)



### 3.2. Geographical Distribution of CVD in Pregnancy Guidelines:

The guidelines on CVD in pregnancy from WHO, international professional organizations, MOH and national professional organizations in low-middle income countries (LMICs) were spread across the continents (Fig.3.2). All the guidelines published by the WHO and international professional organizations were headquartered in high-income countries. From LMICs, a total of four guidelines were published by national professional organizations in Brazil, China, Pakistan, and Sri Lanka. The remaining three guidelines were published by MOH in Malaysia, Peru, and South Africa.

**Fig.3.2. Distribution of guidelines on cardiovascular diseases in pregnancy across countries/regions by the type of publisher (N=17)**



### 3.3. Components of Guidelines on Cardiovascular Diseases in Pregnancy:

The guidelines on CVD in pregnancy mainly focused on two groups of cardiovascular diseases: hypertensive disorders of pregnancy (HDP) and heart diseases in pregnancy [Table 3.1].

The guidelines on HDP made recommendations for the care of women with hypertension, preeclampsia, eclampsia, and HELLP syndrome. Among the guidelines on HDP, the recommendations of the guidelines focusing on pre-eclampsia are presented separately.

#### Guidelines on the Hypertensive Disorders of Pregnancy

Out of the seventeen guidelines included in the review, fourteen guidelines (seven guidelines published by WHO, two guidelines by IPOs- FIGO and ISSHP, two guidelines by MOH- Peru and South Africa and three guidelines by NPOs- CMA China, SLCOG Sri Lanka and SOGP Pakistan) covered hypertensive disorders of pregnancy (HDP), and only three guidelines - IPO(ESC), MOH (Malaysia), and NPO (BCS Brazil) covered heart diseases of pregnancy with a separate chapter on HDP [Table 3.2]. These three guidelines on heart diseases in pregnancy include

recommendations for the prevention, screening, and management of HDP (including pre-eclampsia) in all stages of pregnancy, from the preconception stage to the long term after delivery [Tables 3.2 and 3.3].

Guidelines on pre-eclampsia only: Six guidelines (five guidelines by the WHO and one guideline by an IPO (FIGO)) focused only on pre-eclampsia. Two of the WHO guidelines were on 'calcium administration for prevention of preeclampsia' (14, 15), and one on 'antiplatelet agents for prevention of preeclampsia' (16) which contained recommendations for prevention of preeclampsia in the pre-conception and during the antenatal period. Two further guidelines from WHO gave recommendations for management of pre-eclampsia (17, 18) in the antenatal, intrapartum, and postpartum stages of pregnancy. None of the WHO guidelines gave recommendations on pre-eclampsia screening during preconception, antenatal, intrapartum, or postpartum stages [Table.3.2], nor longer-term care after a pregnancy affected by pre-eclampsia [Table.3.3].



The guideline published by FIGO gave recommendations for prevention and screening of pre-eclampsia in the preconception and antenatal stages, but did not include recommendations on management of pre-eclampsia [Table 3.2] during pregnancy or long-term care after pregnancy [Table 3.3].

Guidelines on HDP (including pre-eclampsia): Eight guidelines were identified describing recommendations for care of women with HDP. These guidelines were published by the WHO, IPO- ISSHP, MOH- Peru and South Africa, and NPOs- CMA China, SLCOG Sri Lanka, and SOGP Pakistan (Table 3.1).

Two WHO guidelines (19, 20) gave recommendations for the management of HDP in the antenatal period, but no recommendations on prevention or screening [Table 3.2]. The guideline from the MOH Peru made recommendations on the prevention of HDP in the antenatal period and management during pregnancy and birth, but also did not include screening for HDP during pregnancy [Table 3.2]. This guideline did not make any recommendations for pre-conception, postpartum or for long-term care [Table 3.3]. In contrast, the guidelines by ISSHP and MOH South Africa gave recommendations for the prevention, screening, and management of HDP [Table 3.2] across all stages of pregnancy, however also gave no information on pre-conception care [Table 3.3]. The Sri Lankan (SLCOG Sri Lanka) guidelines gave

recommendations on the prevention, screening, and management of HDP across all stages of pregnancy, yet do not include recommendations for long-term care after delivery [Table 3.3]. Only the guidelines from China (CMA China) and Pakistan (SOGP Pakistan) gave recommendations for the prevention, screening, and management of HDP across all stages of pregnancy [Table 3.3].

#### (a) Guidelines on heart disease in pregnancy:

Three organizations – the ESC, MOH Malaysia and BCS Brazil – have published guidelines for the prevention, screening, and management of cardiac diseases in pregnancy (Table 3.2). Conditions addressed by these guidelines were: aortic disease, arrhythmias, cardiomyopathies, congenital heart disease, coronary artery disease, heart failure, pulmonary hypertension, and valvular heart diseases.

All three guidelines made recommendations for care for heart diseases across all four stages of pregnancy (i.e., pre-conception to the postpartum stage). None of the guidelines, except the MOH, Malaysia guideline (21) contained detailed recommendations regarding long-term care and follow-up of heart diseases after the postpartum period. We did not identify any guidelines to address prevention, screening, and management of cerebrovascular diseases (e.g. stroke or cerebral venous thrombosis) in pregnancy. [Table 3.3]

**Table 3.2: Guidelines addressing the cardiovascular needs in pregnancy by publisher**

Type of publisher	Publisher	Hypertensive disorders of pregnancy (HDP)						Heart Diseases in pregnancy		
		Preeclampsia			Hypertensive disorders other than preeclampsia*					
		Prevention	Screening	Management	Prevention	Screening	Management	Prevention	Screening	Management
	WHO	√ <sup>#</sup>		√ <sup>##</sup>			√ <sup>@</sup>			
International Professional Organizations	ESC	√	√	√	√	√	√	√	√	√
	FIGO	√	√							
	ISSHP	√	√	√	√	√	√			
Ministry of Health	MOH, Malaysia	√	√	√	√	√	√	√	√	√
	MOH, Peru	√		√	√		√			
	MOH, South Africa	√	√	√	√	√	√			
National Professional Organization	BCS, Brazil	√	√	√	√	√	√	√	√	√
	CMA, China	√	√	√	√	√	√			
	SLCOG, Sri Lanka	√	√	√	√	√	√			
	SOGP, Pakistan	√	√	√	√	√	√			

\*HDP other than pre-eclampsia : chronic hypertension, gestational hypertension and white-coat hypertension

(WHO- World Health Organization, ESC- European Society of Cardiology, FIGO- The International Federation of Gynecology and Obstetrics, ISSHP- International Society for the Study of Hypertension in Pregnancy, MOH- Ministry of Health, BCS- Brazilian Cardiology Society, CMA- Chinese Medical Association, SLCOG- Sri Lanka College of Obstetricians and Gynaecologists, SOGP- Society of Obstetricians and Gynaecologists Pakistan)

# Two WHO guidelines on calcium administration for prevention of preeclampsia and one WHO guideline on antiplatelet agents for prevention of preeclampsia

## One WHO guideline on prevention and treatment of preeclampsia and WHO Guideline on interventionist vs expectant management of preeclampsia

@ Two WHO Guidelines on drug treatment for hypertension in pregnancy

**Table.3.3. Cardiovascular Disease (CVD) conditions of pregnant women and the timing of recommendations of the guidelines based on the stages of pregnancy\***

Type of publisher	Publisher	Cardiovascular diseases									
		HDP		Heart diseases in pregnancy							
		Pre-eclampsia	HDP other than pre-eclampsia**	Aortic Diseases	Arrhythmia	Cardiomyopathy	Congenital Heart Diseases	Coronary Artery Diseases	Heart Failure	Pulmonary Hypertension	Valvular Heart Diseases
International Professional Organizations	WHO	●●●●●	●								
	ESC	●●●●●	●●●●●	●●●●●	●●●●●	●●●●●	●●●●●	●●●●●	●●●●●	●●●●●	●●●●●
	FIGO	●●									
	ISSHP	●●●●●	●●●●●								
Ministry of Health	MOH, Malaysia	●●●●●	●●●●●	●●●●●	●●●●●	●●●●●	●●●●●	●●●●●	●●●●●	●●●●●	●●●●●
	MOH, Peru	●●	●●								
	MOH, South Africa	●●●●●	●●●●●								
National Professional Organization	BCS, Brazil	●●●●●	●●●●●	●●●●●	●●●●●	●●●●●	●●●●●	●●●●●	●●●●●	●●●●●	●●●●●
	CMA, China	●●●●●	●●●●●								
	SLCOG, Sri Lanka	●●●●●	●●●●●								
	SOGP, Pakistan	●●●●●	●●●●●								

Stages of Pregnancy: pre-conception ● antenatal ● intranatal ● postpartum ● long term after pregnancy ●

(WHO- World Health Organization, ESC- European Society of Cardiology, FIGO- The International Federation of Gynecology and Obstetrics, ISSHP- International Society for the Study of Hypertension in Pregnancy, MOH- Ministry of Health, BCS- Brazilian Cardiology Society, CMA- Chinese Medical Association, SLCOG- Sri Lanka College of Obstetricians and Gynaecologists, SOGP- Society of Obstetricians and Gynaecologists Pakistan) \*\*HDP other than preeclampsia: chronic hypertension, gestational hypertension and white-coat hypertension

### 3.3.1 Recommendations for the care of women with Hypertensive Disorders of Pregnancy (HDP):

#### a. Pre-conception care:

Pre-conception care is recommended for women who are at risk of HDP and are planning for pregnancy. It consists of nutrition advice and supplementation, lifestyle modification, behavioral changes, risk counseling for women and their families as well as controlling risk factors such as blood pressure.

A total of eight guidelines recommend preconception care for HDP. Of these three guidelines, (ESC, MOH Malaysia, and BCS Brazil) recommend preconception care for all CVDs. HDP was one of the components in these guidelines, which are presented in Section 3.5.2. However, five guidelines (WHO, FIGO, and three NPOs (CMA China, SLCOG Sri Lanka, and SOGP Pakistan)) - recommend preconception care specifically for HDP. The FIGO guideline recommends providing pre-conception care to pregnant women but does not give any specific recommendations.

- Nutrition- Among the dietary recommendations, SOGP Pakistan recommended a reduction in salt intake in the diet. In contrast, SLCOG Sri Lanka recommended against salt restriction. Supplementation with folic acid is recommended by the SOGP Pakistan. The WHO (14) recommended the administration of calcium for the prevention of pre-eclampsia before pregnancy.
- Lifestyle modifications- Optimum body weight management and adopting a healthy lifestyle with regular physical activity were recommended by SGOP Pakistan and CMA China.
- Behavioral changes- SOGP Pakistan recommended cessation of smoking and alcohol use before pregnancy.
- Evaluation- SOGP Pakistan and SLCOG Sri Lanka recommended renal, cardiac, and obstetric evaluations and evaluations of comorbidities among women with hypertension or risk factors.
- Risk counseling- SOGP Pakistan gave detailed recommendations to inform women with

hypertension regarding the risks of HDP and adverse pregnancy outcomes, along with the potential interventions to reduce these risks. It also recommends information regarding the expected course of pregnancy, the need for surveillance, referral, and periodic obstetric visits.

- **Risk factor (high blood pressure) control-** Three guidelines (CMA China, SLCOG Sri Lanka, and SOGP Pakistan) recommended achieving control of blood pressure among hypertensive patients within the limit of 130/85 mmHg prior to conception.

## **b. Antenatal care:**

### **i. Screening and Risk Assessment for Hypertensive Disorders of Pregnancy**

Nine guidelines recommend screening and risk assessment for HDP in pregnancy. Of these nine guidelines, three were published by IPO (ESC, FIGO, and ISSHP), two were published by MOH (Malaysia and South Africa), and four were published by NPO (BCS Brazil, CMA China, SLCOG Sri Lanka, and SOGP Pakistan). Table 3.4 summarizes the recommendations for screening tests and risk assessment for HDP in pregnancy.

*The guidelines recommend the time and parameters of assessment, and a risk calculator is used for screening and risk assessment for HDP. The detailed description is mentioned below:*

Of these nine guidelines, the time of assessment for screening and risk stratification for HDP in pregnancy is recommended by five guidelines. Whilst the CMA China guideline specifies that the screening and risk assessment to be conducted at 20 weeks of gestation, the remaining four guidelines recommend screening and risk stratification for HDP should occur in the first trimester of pregnancy.

**Parameters of assessment** These include maternal history taking and risk assessment, blood pressure measurement, BMI assessment, urine test, blood routine and biochemical investigations, biomarkers of HDP, and uterine artery doppler ultrasound.

- **Maternal history taking and risk assessment:** Seven out of the nine guidelines recommended taking a previous history of HDP and other risk factors of the pregnant woman, and family history to assess the risk of HDP in pregnancy.
- **Blood pressure measurement:** All the guidelines recommended measuring blood pressure for screening and risk assessment of HDP in pregnancy. BCS Brazil, SOGP Pakistan and FIGO

further specified that Mean Arterial Pressure (MAP)<sup>1\*</sup> is a reliable method for screening HDP in pregnancy.

- **Body mass index (BMI) Assessment:** Five guidelines recommended using BMI as part of the risk assessment.
- **Urine investigation:** Six guidelines recommended urine testing for proteinuria. These six guidelines were published ISSHP and ESC, MOH South Africa, and CMA China, SLCOG Sri Lanka, and SOGP Pakistan.
- **Blood routine and biochemical investigations:** Seven guidelines recommended a full blood profile and biochemical investigations, including serum creatinine and liver profile, to assess the risk for HDP.
- **Biomarkers of HDP:** Seven guidelines made recommendations for serum biomarkers such as Placental Growth Factor (PlGF) and Pregnancy Associated Plasma Protein-A (PAPP-A) to assess risk for HDP. These were from international organizations and middle income countries (ESC, FIGO, CMA China and SLCOG Sri Lanka). In contrast, ISSHP, MOH South Africa, and NPO SOGP Pakistan recommended against these tests because their predictive value is still inconclusive.
- **Uterine artery doppler ultrasound investigation:** The recommendations to use doppler ultrasound, such as uterine artery doppler, varied between guidelines. Five guidelines published by three IPOs [ESC, FIGO, and ISSHP] and two NPOs [SLCOG Sri Lanka and SOGP Pakistan] recommend the use of ultrasound in all women for risk stratification for HDP. The IPO (ESC) guideline recommends the use of doppler ultrasound in pregnant women who are at high risk of HDP. The IPO (FIGO) and NPO (SOGP, Pakistan) recommend measuring the Uterine Artery Pulsatility Index (UTPI) for screening for pre-eclampsia.

**Risk calculator use:** Only two guidelines published (FIGO and SOGP, Pakistan) recommended the use of an online risk calculator, to assess the risk of HDP among pregnant women. These guidelines further specify the information, including the history of previous episodes of HDP, the presence of risk factors of HDP, and the results of clinical assessments, blood tests, and doppler investigations required to produce a numerical risk score for the risk of HDP for each pregnant woman.

1 \*Mean Arterial Pressure, MAP=Diastolic Blood Pressure +(Systolic Blood Pressure- Diastolic Blood Pressure)/3

Table 3.4.1 summarizes the similarities and differences in the guidelines published by IPOs, MOHs and NPOs on screening and risk assessment for HDP. There was consensus in all guidelines on the importance of blood pressure for screening.

**Table 3.4. Recommendations to screen and assess risk for hypertensive disorders of pregnancy**

Type of Publisher	Publisher	Time of Assessment	History & Maternal Risk Factors	Clinical assessment		Urine test for proteinuria	Blood Tests		Uterine Artery Doppler	Risk Calculator* Use
				BP	BMI		Blood routine/ biochemical tests <sup>a</sup>	bio markers E.g.PIGF/ PAPP**		
International Professional Organization	ESC	-	●	●	●	●	●	●	# ●	●
	FIGO	First trimester	●	●	●	●	●	●	●	●
	ISSHP	First trimester	●	●	●	●	●	●	●	●
Ministry of Health	MOH, Malaysia	-	●	●	●	●	●	●	●	●
	MOH South Africa	First trimester	●	●	●	●	●	●	●	●
National Professional Organization	BCS, Brazil	-	●	●	●	●	●	●	●	●
	CMA, China	After 20 weeks	●	●	●	●	●	●	●	●
	SLCOG Sri Lanka	-	●	●	●	●	●	●	●	●
	SOGP, Pakistan	First trimester	●	●	●	●	●	●	●	●

Recommended ● Not Recommended ● No mention in the guidelines. ●

(ISSHP- International Society for the Study of Hypertension in Pregnancy, ESC- European Society of Cardiology, FIGO- The International Federation of Gynecology and Obstetrics, MOH- Ministry of Health, BCS-Brazilian Cardiology Society, CMA- Chinese Medical Association, SLCOG- Sri Lanka College of Obstetricians and Gynaecologists, SOGP- Society of Obstetricians and Gynaecologists Pakistan) (BP- Blood Pressure, MAP- Mean Arterial Pressure, BMI- Body Mass Index)

#blood tests for biomarkers such as Placental Growth Factor (PIGF) and pregnancy associated plasma protein-A (PAPP-A)

\*Risk Calculator- Online tool to estimate risk of preeclampsia/ eclampsia, based on the parameters measured- (<https://fetalmedicine.org/research/assess/preeclampsia/first-trimester>)

# Only in higher risk group @ Blood routine/ biochemical tests - full blood count, blood picture, serum creatinine, liver profile, PT/INR e.t.c

\*\*Placental Growth Factor (PIGF) and pregnancy associated plasma protein-A (PAPP-A)

**Table.3.4.1. Similarities and differences between guidelines recommending screening and risk assessment on Hypertensive Disorders of Pregnancy (HDP)**

Similarity/ Differences in recommendations	Theme	IPO (n=3)	MOH (n=2)	NPO (n=4)
Similar	Maternal clinical assessment- Blood Pressure	●●●	●●●	●●●
Partially similar	Time of assessment (1 <sup>st</sup> trimester) specified	●●●	●●●	●●●
	Maternal history taking and identification of pre-existing risk factors	●●●	●●●	●●●
	Maternal clinical assessment- BMI	●●●	●●●	●●●
	Urine investigation for proteinuria	●●●	●●●	●●●
	Blood Routine and biochemical tests	●●●	●●●	●●●
	Use of Doppler ultrasound studies (such as uterine artery Doppler)	●●●	●●●	●●●
	Online risk calculator* for risk assessment	●●●	●●●	●●●
Different	Use of biomarkers - Placental Growth Factor (PIGF) and pregnancy associated plasma protein-A (PAPP-A)	●	●	●

\*Risk calculator- A digital tool available online to collate all the information from history, clinical assessment, blood testing and Doppler studies to produce a numerical risk score. ((International Professional Organizations (IPO) - International Society for the Study of Hypertension in Pregnancy(ISSHP), ESC- European Society of Cardiology (ESC), The International Federation of Gynecology and Obstetrics (FIGO), Ministry of Health- MOH Malaysia and South Africa, National Professional Organizations (NPO)- Brazilian Cardiology Society (BCS Brazil), Chinese Medical Association (CMA China), Sri Lanka College of Obstetricians and Gynaecologists (SLCOG Sri Lanka), Society of Obstetricians and Gynaecologists Pakistan (SOGP Pakistan))

#### Legend:

All guidelines recommend ● Not Recommended ● Partially similar- At least one guideline differs from others in recommendations ●

Recommendations are different in all the guidelines ●

## ii. Recommendations for Drugs to Prevent Pre-eclampsia/Eclampsia:

### *Aspirin for the prevention of pre-eclampsia:*

A total of eleven guidelines published by the WHO, three IPOs (ESC, FIGO and ISSHP), three MOHs (Malaysia, Peru, and South Africa), and four NPOs (BCS Brazil, CMA China, SLCOG Sri Lanka, and SOGP Pakistan) recommended the administration of aspirin for pre-eclampsia prophylaxis. However, recommendations for the dosage of aspirin and recommendations for commencing and stopping periods of aspirin varied across guidelines.

Table 3.5 presents the recommendations for dosage, commencement, and stopping of aspirin for preventing pre-eclampsia. **Aspirin dosage** recommendations range from 75mg to 162mg.

Recommendations for **the commencement time of aspirin** also varied between guidelines, ranging from 12-20 weeks.

Similarly, there was variation in the recommendations for the **cessation time of aspirin** between guidelines, from 36 weeks to delivery. (Table 3.5).

**Table.3.5. Recommendations for prescribing Aspirin to prevent pre-eclampsia**

Type of Publisher	Publisher	Dose (mg/day)	Commencement time (weeks)	Time of Cessation
WHO	WHO	75 mg	20 weeks, or as soon as antenatal care started	Not mentioned in the guideline
International Professional Organizations	ESC	100-150	12	36-37 weeks
	FIGO	150	11-14 <sup>16</sup>	36 weeks or until pre-eclampsia is diagnosed
	ISSHP	150	Before 16, definitely before 20 weeks	Delivery
Ministry of Health	MOH, Malaysia	75	12	Delivery
	MOH, Peru	100-150	12-16	Not mentioned in the guideline
	MOH, South Africa	75-162	12-14 (up to 20)	Not mentioned in the guideline
National Professional Organizations	BCS, Brazil	75-150	12-16	5 days before delivery
	CMA, China	50-150	12-16	26-28 weeks
	SOGP, Pakistan	150	Before 16	36 weeks
	SLCOG, Sri Lanka	75-150	13	Delivery

(WHO- World Health Organization, ESC- European Society of Cardiology, FIGO- The International Federation of Gynecology and Obstetrics, ISSHP- International Society for the Study of Hypertension in Pregnancy, MOH- Ministry of Health, BCS- Brazilian Cardiology Society, CMA- Chinese Medical Association, SLCOG- Sri Lanka College of Obstetricians and Gynaecologists, SOGP- Society of Obstetricians and Gynaecologists Pakistan)

### **Calcium for prevention of pre-eclampsia:**

Eight guidelines recommended calcium supplementation in pregnancy for preventing pre-eclampsia. IN contrast, MOH (Malaysia) and SLCOG Sri Lanka both recommended against prescribing calcium due to the lack of evidence suggesting calcium supplementation to be beneficial. Table.3.6. presents recommendations for prescribing calcium supplementation.

**Calcium dosage recommendations** also varied between guidelines from 0.5g to 2.5g, as did **indications for calcium supplementation for pregnant women**.



**Table.3.6. Recommendations for prescription of Calcium for the prevention of pre-eclampsia**

Type of Publisher	Publisher	Dose of Calcium (g/day)	Indication for calcium supplementation
WHO	WHO	1.2-2	<900 mg/day intake of calcium from diet
International Professional Organization	ESC	1.5-2	<600 mg/day intake of calcium from diet
	FIGO	1.5-2	<800 mg/day intake of calcium from diet
	ISSHP	1.2-2.5	<600 mg/day intake of calcium from diet
Ministry of Health	MOH Malaysia	Calcium not recommended	Not Applicable
	MOH, Peru	2	high risk pregnant women
	MOH South Africa	0.5	All women
National Professional Organization	BCS, Brazil	1.5-2	<600 mg/day intake of calcium from diet
	CMA, China	1	<600 mg/day intake of calcium from diet
	SOGP, Pakistan	1	high risk pregnant women- >1 in 100 on risk calculator*
	SLCOG, Sri Lanka	Calcium not recommended	Not applicable

(WHO- World Health Organization, ESC- European Society of Cardiology, FIGO- The International Federation of Gynecology and Obstetrics, ISSHP- International Society for the Study of Hypertension in Pregnancy, MOH- Ministry of Health, BCS-Brazilian Cardiology Society, CMA- Chinese Medical Association, SLCOG- Sri Lanka College of Obstetricians and Gynaecologists, SOGP- Society of Obstetricians and Gynaecologists Pakistan)

\*Risk Calculator- Online tool to estimate risk of preeclampsia/ eclampsia, based on the parameters measured- (<https://fetalmedicine.org/research/assess/preeclampsia/first-trimester>) given in FIGO and SOGP guideline

### iii. Recommendations for Antihypertensive Administration:

**Antihypertensives indicated for pregnancy:** All twelve guidelines recommended two levels of treatment for administering antihypertensive medication in pregnancy based on the severity of hypertension.

The first level of treatment is for controlling **non-severe** hypertension (newly diagnosed or previously existing chronic hypertension) in pregnancy.

Seven guidelines recommended initiation of medical treatment for blood pressures above 140/90 mm Hg. (ISSHP, ESC, MOHs (South Africa and Peru), and BCS Brazil, SOGP Pakistan, and SLCOG Sri Lanka). The MOH Malaysia, however, recommends a threshold of 100 mmHg of diastolic BP to start antihypertensive medications. The WHO recommends initiating drug administration (described below) for non-severe hypertension but does not define 'non-severe hypertension' in the guideline. The guidelines recommend varying **targets to aim for maintaining blood pressure** within safe limits. ISSHP recommends a target blood pressure of less than 160/80-85 mm Hg, while the MOH (South Africa) recommends a target of below 160/110 mm Hg. MOH (Malaysia) and NPO (SLCOG Sri Lanka) recommend a target value of less than 150/80-110 mm Hg. NPO (BCS Brazil) recommends a target blood pressure of less than 110-140/80-85 mm Hg, while NPO (SOGP Pakistan) recommends a target value of 130/85 mm Hg for BP control. NPO: The IPO (ESC) recommends no target BP value for controlling hypertension.

*The guidelines recommended beta-blockers, alpha-methyldopa, and nifedipine as antihypertensive medications for treating non-severe hypertension in pregnancy.*

- **Beta blockers:** Labetalol was recommended as first line by some guidelines, and second line by others. Dosages varied from 200-800 mg, 50-150 mg (3-4 times a day) and 100-2,400 mg.
- **Alpha-methyldopa was recommended** by eight guidelines. Again there were variations in dose from MOH (Malaysia) recommends a 250-1000 mg dose, to 250-750 mg, all three times a day. The BCS Brazil recommended alpha-methyldopa to control long-term antepartum blood pressure.
- **Long-acting/Extended-release oral nifedipine** was recommended by several guidelines, and as the first line antihypertensive in two guidelines. The dose recommendation for nifedipine ranged from between guidelines published by different organizations from 20-60 mg (twice a day)
- One guideline (ISSHP) recommended hydralazine and prazosin, with either A-Methyldopa or nifedipine for low-resource settings.
- BSC Brazil recommended clonidine, hydralazine, and thiazide diuretics for hypertension control.



The second level of recommendation is for **rapid control of blood pressure in severe hypertension** involving acute emergencies. Most guidelines recommended a blood pressure threshold of 160/110 mm Hg to be considered as **severe hypertension** in pregnant women as an acute emergency and to start rapid blood pressure control. The WHO recommends antihypertensive medications for severe hypertension but does not define 'severe hypertension' in the guidelines.

To control severe hypertension, the WHO recommends hydralazine, alpha-methyldopa, beta-blockers (including labetalol), and nifedipine. However, the WHO guidelines do not specify the route of administration, dosage, etc but mention that the choice of drug to manage blood pressure should be decided by the prescribing clinician.

*The other guidelines, however, recommended medications to control rapid blood pressure, which are mentioned below.*

- **Nifedipine:** Ten guidelines recommend a 10 mg dosage of oral nifedipine.
- **Intravenous labetalol** is also recommended by the above-mentioned guidelines for rapid control of blood pressure in pregnant women. All guidelines recommend a dosage of 20-150 mg/hr.
- **Intravenous administration of hydralazine** is recommended as second line by several guidelines, although notably the ESC guideline prohibits the use of hydralazine for controlling hypertension due to its adverse effects on perinatal health.
- **Nitroglycerin** (glyceryl trinitrate) is recommended by three guidelines for controlling preeclampsia-associated acute pulmonary edema.
- **Sodium nitroprusside** is recommended by three

guidelines in extreme situations to avoid the risk of fetal cyanide poisoning.

- **The other drugs** recommended by the IPO [ESC and ISSHP], MOH [Malaysia], and NPO [CMA China] guidelines include urapidil, prazosin, nimodipine, phentolamine, and nicardipine.

Six guidelines gave recommendations to avoid **antihypertensive medications, which are contraindicated during pregnancy** for pregnant women with hypertension, due to potential fetal risk. The guidelines prohibit the use of angiotensin-converting enzyme inhibitors (ACE-I) and angiotensin receptor blockers (ARB) due to the risk associated with renal damage in the fetus. For pregnant women who were diagnosed as hypertensive before pregnancy and were already on any of the above-mentioned contraindicated antihypertensives, the recommendation is to change to a safer options as soon as pregnancy is confirmed.

At the same time, recommendations on contraindicated medications between guidelines varied for certain antihypertensive medications. For example, the WHO prohibits the use of sodium nitroprusside in pregnancy, but the IPO (ESC) and NPOs (CMA China and BCS Brazil) recommend its use cautiously in extreme situations such as refractory hypertension or severe hypertension with a risk of death. Similarly, NPO (SOGP Pakistan) and MOH (Malaysia) prohibit the use of thiazide diuretics in pregnancy, but NPO (BCS Brazil) recommends it as a second line of antihypertensive medication.

Regarding the recommendations on drug administration in HDP for prevention and management, there were similarities and differences across the guidelines. Table 3.6.1 shows *the similarities and differences in drug administration as recommended by the guidelines on HDP*.

**Table 3.6.1 Similarities and differences in the recommendations regarding drug administration among guidelines on Hypertensive Disorders of Pregnancy (HDP)**

Drug	No: of guidelines providing recommendations				Choice of drug	Dosage prescribed	Indication for administration	Time of administration
	WHO	IPO	MOH	NPO				
Aspirin	1	3	3	4				
Calcium	2	3	3	4				
Antihypertensive for non-severe hypertension	2	3	3	4				
Antihypertensive for rapid BP control	2	3	3	4				

(WHO- World Health Organization, International Professional Organizations (IPO) - International Society for the Study of Hypertension in Pregnancy (ISSHP), ESC- European Society of Cardiology (ESC), The International Federation of Gynecology and Obstetrics (FIGO), Ministry of Health- MOH Malaysia and South Africa, National Professional Organizations (NPO)- Brazilian Cardiology Society (BCS Brazil), Chinese Medical Association (CMA China), Sri Lanka College of Obstetricians and Gynaecologists (SLCOG Sri Lanka), Society of Obstetricians and Gynaecologists Pakistan (SOGP Pakistan))

Legend	
	Similar recommendations among the guidelines
	Partially similar recommendations (One or more guideline differ from others in recommendations)
	More than half of the guidelines different from each other

*iv. Maternal and fetal monitoring for managing hypertensive disorders of pregnancy (HDP): Maternal monitoring* for signs and symptoms of HDP, including pre-eclampsia, was recommended by IPOs (ESC and ISSHP), MOH (Malaysia and South Africa), and NPOs (BCS, Brazil, CMA China, SLCOG Sri Lanka, and SOGP Pakistan). Table 3.7 presents recommendations of guidelines for monitoring women with HDP.

Further, four NPOs (BCS Brazil, CMA China, SLCOG Sri Lanka, and SOGP Pakistan) specified *intervals for monitoring women with HDP*, but the frequency varied between guidelines. The SCOG Sri Lanka and SOGP Pakistan recommend monitoring once every two weeks, and CMA China recommends once every week. Concurrently, BCS Brazil recommends monitoring at every antenatal visit of pregnant women to the health facility. The IPO (ISSHP) recommends monitoring at 28 and 34 weeks of gestation. The MOH (Malaysia) does not

specify intervals for monitoring and recommends that this should be based on the needs of individual pregnant women.

Regarding the *parameters of monitoring pregnant women*, all eight guidelines recommend regular blood pressure measurement. However, seven guidelines, excluding NPO (BCS Brazil), recommend other assessments such as urinalysis along with blood pressure measurement to monitor HDP in pregnant women. Additionally, IPO (ISSHP), MOH (Malaysia), and NPO (CMA China and SOGP Pakistan) recommend taking maternal history to assess pre-eclampsia risk. The IPO (ISSHP) and MOH (Malaysia) also recommend regular BMI monitoring of pregnant women. Biochemical blood testing is another parameter recommended by IPO (ESC and ISSHP), MOH (Malaysia), and NPOs (CMA China, SLCOG Sri Lanka, and SOGP Pakistan) guidelines.

**Table 3.7. Maternal Monitoring parameters recommended by the guidelines to manage Hypertensive Disorders of pregnancy (HDP)**

Type of Publisher	Publisher	Interval of Surveillance	Blood Pressure Measurement	Urine Dipstick test	BMI	History of Symptoms of Preeclampsia	Biochemical Assessment- Blood tests#
International Professional Organization	ESC	Not mentioned	●	●	●	●	●
	ISSHP	28 and 34 weeks	●	●	●	●	●
Ministry of Health	MOH Malaysia	Individualized	●	●	●	●	●
	MOH South Africa	Not mentioned	●	●	●	●	●
National Professional Organization	BCS Brazil	At all routine antenatal appointments	●	●	●	●	●
	CMA, China	1 week (or even twice/ week for preeclampsia)	●	●	●	●	●
	SLCOG Sri Lanka	2 weeks	●	●	●	●	●
	SOGP Pakistan	2 weeks	●	●	●	●	●

Recommended ● No recommendation ●

(ESC- European Society of Cardiology, ISSHP- International Society for the Study of Hypertension in Pregnancy, MOH- Ministry of Health, BCS-Brazilian Cardiology Society, CMA- Chinese Medical Association, SLCOG- Sri Lanka College of Obstetricians and Gynaecologists, SOGP- Society of Obstetricians and Gynaecologists Pakistan) # Biochemical assessment of blood tests include blood count, hematocrit, liver enzymes, serum creatinine, serum uric acid etc.

*The similarities and differences in the recommendations for monitoring pregnant women having HDP* are shown in Table. 3.7.1. All the guidelines-IPOs (ESC and ISSHP), MOH (Malaysia and South Africa), and NPOs (BCS Brazil, CMA China, SLCOG Sri Lanka, and SOGP Pakistan) recommended BP measurement for monitoring pregnant women, whereas all guidelines except the NPO (BCS Brazil) recommended proteinuria assessment for monitoring HDP.

Only two NPO guidelines (SCOG Sri Lanka and SOGP Pakistan) recommended two weeks as an interval of surveillance for maternal monitoring in HDP. The guidelines also differed in their recommendations for the parameters of monitoring, such as assessment of the history of symptoms for pre-eclampsia, assessment of BMI, and biochemical assessment of blood.

**Table 3.7.1. Similarities and differences in the recommendations for maternal monitoring among the guidelines on Hypertensive Disorders of Pregnancy (HDP)**

Similarity/ Difference in recommendations	Theme	IPO (n=2)	MOH (n=2)	NPO (n=4)
Similar	Blood Pressure measurement	YES	YES	YES
Partially similar	Urine Dipstick assessment for proteinuria	YES	YES	
Different	Interval of surveillance of maternal monitoring parameters			
	History of preeclampsia symptoms			
	BMI Measurement			NO
	Biochemical assessments (blood tests)	YES		

(International Professional Organization (IPO)- ESC- European Society of Cardiology, International Society for the Study of Hypertension in Pregnancy (ISSHP), Ministry of Health-MOH Malaysia and South Africa, National Professional Organization (NPO)- BCS-Brazilian Cardiology Society SLCOG- Sri Lanka College of Obstetricians and Gynaecologists, SOGP- Society of Obstetricians and Gynaecologists Pakistan)

# Biochemical assessment of blood tests include blood count, hematocrit, liver enzymes, serum creatinine, serum uric acid etc

Legend	
YES	All guidelines recommend 'yes'
	Partially similar: At least one guideline differs from others in recommendations
NO	All guidelines recommend No
	Different in recommendations

### Fetal Monitoring:

The IPO (ISSHP), MOH (Malaysia and South Africa) and NPOs (CMA China, SLCOG Sri Lanka and SOGP Pakistan) recommend fetal monitoring during pregnancy. The MOH (Malaysia) and NPO (CMA China) recommend measuring symphysis-fundal height during antenatal visits. The NPO (SOGP Pakistan) recommends measuring symphysis-fundal height and, at the same time, specifies in their guidelines that this is not an accurate way to measure fetal growth.

Concurrently, MOH (Malaysia), and NPOs (CMA China and SOGP Pakistan) also recommended the Doppler test for fetal heart identification at each antenatal visit. The MOH (South Africa) recommends the use of a sonar test after a hypertensive disorder is diagnosed. Further, the MOH (Malaysia) and NPOs (CMA, China, and SOGP Pakistan) recommend 'Kick Charts' for pregnant women to identify the frequency of fetal movements. The lack of consensus on fetal monitoring methods and frequency is a significant gap. The guidelines have different recommendations on how to monitor fetal well-being and how often such monitoring should occur.

### c. Intrapartum care: Planning the birth in Hypertensive Disorders of Pregnancy (HDP):

#### i. Referral

The WHO, IPO (ESC and ISSHP), MOH (Malaysia, Peru, and South Africa), and NPOs (BCS Brazil, CMA China, SLCOG Sri Lanka, and SOGP Pakistan) recommend prompt referral of women with severe hypertension and preeclampsia to a higher health facility. The IPO (ISSHP

and ESC) and NPOs (BCS Brazil and SOGP Pakistan) recommend a blood pressure measurement of 170/110 mmHg or >160/110 mmHg as the threshold for referring a pregnant woman for admission at a higher health facility. The variation in blood pressure (BP) thresholds for admission, as specified by only four guidelines- IPOs (ISSHP and ESC) and NPOs (BCS Brazil and SOGP Pakistan), underscores the lack of consensus in this critical aspect of HDP management. Determining the appropriate BP threshold for admission is essential to ensuring that individuals with HDP receive timely medical attention and monitoring. Another significant gap is the omission of detailed guidance on the symptoms and signs of pre-eclampsia that warrant diagnosis.

#### ii. Timing of Delivery

For HDP without severe symptoms or complications, the IPO (ISSHP and ESC), MOH (Malaysia, Peru), and NPOs (BCS Brazil, CMA China, SLCOG Sri Lanka, and SOGP Pakistan) guidelines recommend delivery after 37 weeks, and the NPO (SOGP Pakistan) recommends delivery at 38-39 weeks of gestation. The MOH (Malaysia) and NPO (SOGP Pakistan) recommend that the delivery must be conducted within a maximum of 40 weeks for women with uncomplicated hypertension.

For HDP with hypertensive emergencies or with symptoms of pre-eclampsia or complications, MOH (Malaysia) and NPO (SOGP Pakistan) recommend that the delivery must be conducted within 37 weeks. The MOH South Africa (22) 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) specifically recommends initiation of labor at 34 weeks if there is the development of serious maternal complications (e.g., eclampsia, pulmonary edema, uncontrollable severe hypertension, renal dysfunction, coagulopathy, etc.) The NPO (CMA China) recommends that if the gestation is more than 26 weeks, for severe gestational hypertension and severe preeclampsia, delivery could be attempted. But if the gestational age is less than 26 weeks, delivery may be conducted only if the treatment of HDP is ineffective. All eight guidelines recommend immediately conducting the delivery of pregnant women with eclampsia.

The disparities in the recommended optimal time of delivery among different guidelines highlight the lack of uniformity in clinical practice. These variations, such as 37 weeks according to eight guidelines- IPOs (ISSHP and ESC), MOHs (Malaysia, Peru), and NPOs (BCS Brazil, CMA China, SLCOG Sri Lanka, and SOGP Pakistan), 38-39 weeks according to NPO (SOGP Pakistan), 40 weeks maximum (if uncomplicated) or 37 weeks (if preeclampsia) by MOH (Malaysia), and 34 weeks by MOH (South Africa), reflect the need for evidence-based consensus to guide practitioners in determining the safest and most appropriate delivery timing for pregnant individuals with HDP.

### iii. Interventions and Delivery Methods-

Four guidelines published by the WHO, IPO (ISSHP), MOH (South Africa), and NPO (SOGP Pakistan) respectively recommend interventions and delivery methods in HDP, including pre-eclampsia. Of these four guidelines, the WHO recommends that pregnant women before 36 weeks of gestation with severe pre-eclampsia should be managed without induction of labor or interventions for delivery (expectant management). A similar recommendation is mentioned in the IPO (ISSHP) guideline, which recommends attempting delivery only after 37 weeks of gestation.

Further, MOH (South Africa) and NPO (SOGP Pakistan) recommend vaginal delivery for pregnant women with HDP unless there are obstetric complications requiring cesarean delivery. Similarly, the MOH (South Africa) recommends shortening the second stage with forceps or vacuum delivery if hypertension is uncontrollable.

### iv. Magnesium Sulfate Administration-

A total of 10 guidelines recommend administering magnesium sulfate ( $MgSO_4$ ) to prevent convulsions due to eclampsia. The guidelines were published by the WHO,

IPOs (ESC and ISSHP), MOHs (Malaysia, Peru, and South Africa), and NPOs (BCS, CMA, SLCOG, and SOGP).

**Dosage of  $MgSO_4$ -** The  $MgSO_4$  dosage and route of administration recommended are 4 g through intravenous injection (IVI) slowly for 20 minutes, according to all 10 guidelines. Additionally, IPO (ISSHP) and MOH (Malaysia and South Africa) also recommend an intramuscular injection. For the IV administration, all 10 guidelines recommend an infusion dose of 1 g/hour until delivery and for at least 24 hours postpartum. However, only the SLCOG Sri Lanka includes recommendations in case of an eclamptic fit, whereby the infusion should be continued for 24 hours after the last fit. In cases of recurrent fits, a further dose of 2-4 g over 5 to 15 minutes is also recommended. The MOH (Malaysia) and NPO (BCS Brazil) recommend close clinical monitoring to avoid magnesium toxicity.

### **Indications for $MgSO_4$ administration in pre-eclampsia:**

Nine guidelines, including the WHO, IPO (ISSHP), MOH (Malaysia, Peru, and South Africa), and NPO (BCS Brazil, CMA China, SLCOG Sri Lanka, and SOGP Pakistan), mention conditions for prescribing  $MgSO_4$  to prevent eclamptic fits in pregnancy with HDP. The conditions are severe hypertension (SBP/DBP > 160/110 mmHg) and preeclampsia with severe features (headache, chest or epigastric pain, visual disturbances) or eclampsia. The NPO (SOGP Pakistan) also recommends that  $MgSO_4$  can be used if specific neurological signs of impending eclampsia are elicited upon examination, such as sustained clonus or heightened reflexes. The IPO (ISSHP) guideline recommends the administration of  $MgSO_4$  to all women with pre-eclampsia in low-resource settings to prevent eclampsia. In high-income settings, they recommend  $MgSO_4$  for women with preeclampsia only if they present with severe symptoms or with severe hypertension. No other guideline makes this distinction. In Table 3.8, summarizes the recommendations for administering  $MgSO_4$  for eclampsia prophylaxis management.

While the indications, dosage, and route of administration are largely similar across the recommendations of the guidelines on HDP, there is a gap in terms of the lack of recommendations for loading doses of  $MgSO_4$  in three guidelines (WHO, IPO- ESC, and MOH Peru) and infusion doses (WHO, IPO-ESC, MOH Peru, and South Africa) in four guidelines. There is also a lack of recommendations regarding the monitoring of magnesium toxicity, except for two guidelines: MOH (Malaysia) and NPO (BCS Brazil). Furthermore, only ISSHP has a specific recommendation for low-resource settings, which is an important aspect regarding HDP care in LMIC.



**Table 3.8. Recommendations for the administration of Magnesium Sulfate for eclampsia prophylaxis**

Type of Publisher	Publisher	Loading Dose	Infusion Dose	Indication for administration of MgSO <sub>4</sub>
WHO	WHO	Not mentioned	Not mentioned	Severe preeclampsia
International Professional Organizations	ESC	Not mentioned	Not mentioned	Not mentioned
	ISSHP	4 g IV or 10 g intramuscular (IMI)	5 g IMI every 4 h or an infusion of 1 g/h. until delivery and for at least 24 hours. post-partum.	proteinuria and severe hypertension or hypertension with neurological signs or symptoms In low-resource settings, all women with pre-eclampsia
Ministry of Health	MOH, Malaysia	4 g slow bolus over 10 minutes. If the IV line is not secure, 10 gm 50% solution (20 ml) is injected	1 g per hour till 24 hours after delivery or convulsion	pre-eclampsia with the risk of eclampsia
	MOH Perú	Not mentioned	Not mentioned	preeclampsia with criteria for severity
	MOH South Africa	4 g IVI over 20 minutes, plus 10 g IMI (5 g in each buttock)	Not mentioned	Pre-eclampsia with severe features or BP $\geq$ 160/110 mmHg
National Professional Organizations	BCS Brazil	4 to 6 g IV in a single dose with an infusion pump, for 30 minutes	1 to 2 g per hour, IV. at a rate of 100 ml per hour in a continuous infusion pump. In cases of recurrence of seizure, an additional 2 g IV is administered (bolus)	SBP $\geq$ 170 mmHg or DBP $\geq$ 110 mmHg
	CMA China	4-6 g, slowly over 15-20 minutes.	Or in a 5% glucose solution (100 mg) IV, followed by a 1-2 g/h IV drip. If recurrent, 2-4 g over 2-3 minutes, followed by 1-2 g/h. Total dosage 25-30 g	Severe preeclampsia. Eclamptic convulsions Inducing labor and during labor
	SOGP Pakistan	4 g slowly over 20 minutes.	1-2 g every hour given by an infusion pump	signs and symptoms of Impending eclampsia (sustainable clonus, evidence of hyperreflexia)
	SLCOG Sri Lanka	4 g should be given over 5 to 15 minutes,	1 g/hour maintained for 24 hours. In the case of an eclamptic fit, continue for 24 hours after the last fit. Recurrent fits: further dose of 2-4 g over 5 to 15 minutes	BP>160/110 mm Hg with severe symptoms

(WHO- World Health Organization, ESC- European Society of Cardiology, FIGO- The International Federation of Gynecology and Obstetrics, ISSHP- International Society for the Study of Hypertension in Pregnancy, MOH- Ministry of Health, BCS-Brazilian Cardiology Society, CMA- Chinese Medical Association, SLCOG- Sri Lanka College of Obstetricians and Gynaecologists, SOGP- Society of Obstetricians and Gynaecologists Pakistan)

#### d) Postpartum Care for Hypertensive Disorders of Pregnancy (HDP):

Postpartum care for women who had hypertensive disease during pregnancy was recommended by nine guidelines.

All nine recommend **monitoring of maternal clinical conditions in the immediate postpartum period** in the ICU/CCU/HDP for at least 48 hours after delivery. All these guidelines recommend monitoring blood pressure and pulse rate every 4 hours. The IPO (ISSHP) and NPO (SOGP Pakistan) recommend that for mothers who had preeclampsia during pregnancy, BP should be recorded hourly for the first 2 hours and then every 6-8 hours until 48 hours after delivery. Additionally, they recommend monitoring parameters such as platelet count, transaminases, and serum creatinine for 24-48 hours after birth. The MOH (South Africa) guideline

recommends using a 'colored monitoring chart' for early warning of symptoms in high-care areas. The NPO (CMA China) recommends that women who have HDP should be monitored daily for at least one week postpartum.

The guidelines recommend the **administration of antihypertensive medications** in the postpartum period if the mother had HDP or has increased blood pressure during the postpartum period.

The **duration of hospital stay and time of discharge** varied between the guidelines. Guidelines from IPO (ISSHP), MOH (South Africa), and NPO (SOGP Pakistan) recommend hospital stays for at least 3 days due to the risk of postnatal eclampsia, while ISSHP recommends discharge after the 5th day, and in low-resource settings, the guideline specifically recommends avoiding

discharge before 24 hours post-delivery for women who had preeclampsia during pregnancy. MOH (South Africa) also recommends that women who had HDP should not be discharged 24 hours after delivery. Instead of the day of discharge, guidelines from MOH Malaysia and NPO (CMA China and SOGP Pakistan) recommend discharge only if certain criteria (BP within threshold, no proteinuria, signs and symptoms relieved, patient awareness, and community support in self-care) are met.

**Post discharge, the follow-up care** of women who had had HDP is recommended by IPO (ISSHP), MOH (Malaysia), and NPOs (BCS Brazil, CMA China, and SLCOG Sri Lanka) guidelines, though the frequency of visits varied. The IPO (ISSHP) recommends a review of women with pre-eclampsia within one week if on anti-hypertensive medication during the time of discharge and at 3 months post-partum. The MOH (Malaysia) recommends an everyday review by the nurse and a biweekly review of a doctor until 6 weeks postpartum, along with nurse-led community follow-up. Similarly, the NPO (SOGP Pakistan) also recommends BP monitoring by a health worker in the community or a health facility and a checkup in a hospital in two weeks for BP and proteinuria, along with urine dipstick testing for proteinuria at 6-8 weeks after delivery. The guideline also specifically recommends a review of women who had preeclampsia at 7 days, 6 weeks, and 12 weeks after delivery. The NPO (BCS Brazil) recommends a brief review at 1-2 weeks after discharge for mothers with hypertension, while the NPO (CMA China) recommends follow-up at 6 weeks postpartum, and an additional check-up if BP is not normalized at 12 weeks postpartum.

The gaps in recommendations within guidelines for hypertensive disorders of pregnancy (HDP) for postpartum care highlight several areas where standardization and specificity are needed for optimal patient outcomes. While all nine guidelines agree on maternal monitoring in the immediate postpartum period with BP and pulse rate monitoring, other parameters of monitoring (such as platelet count, transaminases, and serum creatinine) and the frequency of monitoring differ. The variations in the day of discharge, with recommendations ranging from at least 3 days (MOH South Africa, SOGP Pakistan) to after 5 days IPO (ISSHP), reflect the lack of consensus on the appropriate timing of discharge. Additionally, addressing the discharge process in low-resource settings, as recommended by the MOH (South Africa) and IPO (ISSHP), is also missing in all other guidelines. The differences in the recommendations on the frequency of follow-up visits and parameters of follow-up across guidelines highlight a lack of uniformity

in the postpartum care schedule for individuals with HDP. Also, the follow-up of HDP care post-partum in a community setting as recommended by MOH (Malaysia) and (SOGP Pakistan) was not recommended by any other guidelines.

#### e. Long-term follow-up

The guidelines published by IPO (ISSHP), MOH (South Africa), and NPO (SOGP Pakistan) recommend follow-up and review after 3 months postpartum, and IPO (ESC and ISSHP) and NPO (SOGP Pakistan) guidelines recommend annual review for those who had HDP as long-term follow-up.

The lack of recommendations for follow-up visits after the post-partum period for pregnancy with HDP except the four guidelines is a significant gap. Among the guidelines that recommend long-term follow-up, there are differences in terms of recommendations for the frequency of follow-up visits.



### 3.3.2 Recommendations for the management of heart disease in pregnancy:

Three guidelines- the IPO (ESC) (25), MOH (Malaysia) (21), and NPO (BCS Brazil) (26) contained recommendations for the care of cardiac diseases in pregnancy.

#### **a. Pre-conception care: Preparing for pregnancy in women with known heart disease-**

All three guidelines recommend **pre-conception counseling**, with differences in timing of when this should commence and content of advice. MOH (Malaysia) recommends that preconception counseling starts as early as puberty and specifies that it shall be done at least 6 months before conception, while the other two guidelines have no such recommendations. Counseling is recommended by the three guidelines for informed decision-making and individualized planning for each pregnancy, including potential discussions about termination of pregnancy in high-risk scenarios. **Lifestyle modifications** for maintaining a healthy lifestyle, include having a **nutritious diet, weight control, and quitting alcohol or smoking**, are also recommended by all three guidelines during the preconception stage. Furthermore, these guidelines also recommend **contraceptive counseling** and advice to ensure that each pregnancy can be a planned process.

The IPO (ESC) is the only guideline to recommend the **holistic approach** required in pre-conception counseling, which should take into account the emotional and cultural context and any psychological or ethical challenges.

#### **b. Antenatal care:**

##### **i. Maternal and Fetal Risk Estimation-**

All three guidelines recommend using the World Health Organization (WHO) classification of maternal cardiovascular risk and the New York Heart Association (NYHA) functional classification for assessment of maternal risk. The NPO (ESC) is the only guideline to recommend using predictors that have been identified in previous studies, e.g., CARPREG (Cardiac Disease in Pregnancy) study. Furthermore, both MOH (Malaysia) and NPO (ESC) recommend that there should be a full and detailed maternal clinical examination. All three guidelines recommend baseline investigations of an ECG and echocardiography, which should be undertaken in patients with diagnosed CVD. However, the NPO (ESC) is the only guideline to recommend the use of exercise testing in all pregnant patients with CVDs.

##### **ii. Recommendations for Thromboprophylaxis in Pregnancy with CVD-**

All three guidelines recommend anticoagulation administration during pregnancy with heart disease. They recommend low molecular weight heparin (LMWH) or unfractionated heparin (UFH) as a prophylactic agent in pregnancy after 36 weeks. Furthermore, all three guidelines also recommend that 36 hours before a planned delivery, all women should be switched to IV unfractionated heparin. Regarding the use of warfarin, all three guidelines recommend low-dose warfarin therapy depending on the individual needs of the mother; however, they all state that there should be a low threshold for switching to heparin-based therapy.

Risk assessment and stratification for venous thromboembolism is recommended by the IPO (ESC) and MOH (Malaysia), but not recommended in NPO (BCS Brazil) guidelines. While NPO (BCS Brazil) recommends three LMWH (enoxaparin, tinzaparin, and dalteparin) for thromboprophylaxis, MOH (Malaysia) recommends only the first two. The IPO (ESC) recommends only enoxaparin. Also, the IPO (ESC) and MOH (Malaysia) recommend weight-based dosage, while the NPO (BCS Brazil) recommends it only for enoxaparin and recommends a fixed dose for the rest of the drugs. For weight-based dosage, MOH (Malaysia) recommends a threshold of 50 kg, unlike the other two guidelines. The choice of LMWH suggested by each guideline on CVD in pregnancy is given in Table 3.9.

The recommendations for the administration of thromboprophylactic drugs for the prevention of venous thromboembolism differed between the three guidelines on CVD in pregnancy in terms of the choice of drugs (LMWH and UFH) and their dosage. The NPO (BCS) only recommends weight-based dosing for enoxaparin and advises fixed doses for the other medications, in contrast to other guidelines. The MOH (Malaysia) recommends a threshold of 50 kg for determining exposure based on weight. Thus, there is not much consensus on the choice of LMWH and its dosage among the three guidelines.

**Table.3.9. Recommendations for the administration of Low Molecular Weight Heparin (LMWH) for thromboprophylaxis in pregnancy with CVD**

Type of Publisher	Publisher	Risk stratification for VTE*	Choice of LMWH	Dosage
International Professional Organization	ESC	Yes	Enoxaparin	0.5 IU/kg of body weight once daily
Ministry of Health	MOH Malaysia	Yes	Enoxaparin	<50 kg- 20 mg daily >50kg- 40 mg daily
			Tinzaparin 20,000 IU/ml	<50 kg- 3500 IU daily >50kg- 4500 IU daily
National Professional Organization	BCS Brazil	-	Enoxaparin	40 mg or 0.5 mg/kg subcutaneous
			Tinzaparin	4,500 units subcutaneous
			Dalteparin	5,000 units of subcutaneous daily

(ESC- European Cardiology Society, MOH- Ministry of Health, BCS- Brazilian Cardiology Society) \*VTE- Venous Thromboembolism

Meticulous leg care, elastic support stockings, and early ambulation are recommended by all three guidelines to prevent thromboembolism.

### iii. Antibiotic Use in Pregnancy with Cardiac Disease-

The guidelines recommend cautious prescription of antibiotics for the treatment of infectious conditions like infective endocarditis and rheumatic fever, but the recommendations for prophylactic use of antibiotics for any cardiac condition varies between guidelines. According to the IPO (ESC), prophylactic prescription of antibiotics is not recommended for all women with CVD, regardless of the mode of delivery, while both the MOH (Malaysia) and the NPO (BCS Brazil) recommend antibiotic prophylaxis in cardiac diseases, but with different indications for antibiotic use. The NPO (BCS Brazil) recommends that antibiotic prophylaxis should be at the discretion of the obstetrician caring for the patient, while the MOH (Malaysia) recommends antibiotics for specific high-risk sub-groups of pregnant women, such as those with prosthetic valves or previous endocarditis.

In terms of the specific antibiotics that may be considered for use in the intrapartum period, ampicillin and gentamycin are both recommended as first-line drugs if indicated by the MOH (Malaysia) and NPO (BCS Brazil), and both guidelines suggest the same dose schedules.

Antibiotic use in pregnancy is found to be a contested topic among the three guidelines on CVD in pregnancy. While the therapeutic use of antibiotics in conditions such as endocarditis and rheumatic fever was agreed upon by all three guidelines, prophylactic use of antibiotics is not universally recommended. The IPO (ESC) specifies that antibiotic prophylaxis should not be used in pregnancy, while the other two guidelines from the MOH (Malaysia) and BCS (Brazil) differ. Therefore, while the use of antibiotics is contested between guidelines, there is an agreement on the specific antibiotic regime if required.

### iv. Cardiac Interventions During Pregnancy-

Cardiac interventions such as percutaneous therapy and surgical interventions are recommended by all three guidelines based on the cardiac status and needs of pregnant women. The ideal time for intervention, if found essential, was recommended by all the guidelines to be the second trimester of pregnancy, after four months of gestation.

Cardiac surgery is recommended by the guidelines only when medical therapy or interventional procedures fail and the mother's life is threatened. It is also mentioned that, whenever possible, surgery should be carried out after delivery. But in cases of emergencies, the IPO (ESC) recommends cardiac surgery between the 13th and 28th weeks with full maternal and fetal monitoring and attention to cardiopulmonary bypass.

Additionally, if the gestational age is greater than 28 weeks, surgery is recommended after delivery (if >26 weeks, caesarian delivery). MOH (Malaysia) recommends, after 28 weeks, surgery in cases of heart disease during pregnancy. The NPO (BCS Brazil) also recommends the second trimester as the best time to do surgery if needed.

### c. Intrapartum care- Planning Birth in Pregnancy with CVD:

#### i. Time of Delivery-

All three guidelines - IPO (ESC), MOH (Malaysia), and NPO (BCS Brazil)- recommend consultation with the multidisciplinary team led by the obstetrician and cardiologist to assess the woman's cardiac condition and fetal wellbeing to decide on the time of delivery. It is also recommended that induction of delivery should be considered at 40 weeks of gestation in all women with heart disease, considering the risks and benefits.

The NPO (BCS Brazil) recommends delivery from 37 weeks in patients under oral anticoagulation. They also specify that inhibition of premature labor is contraindicated in women with heart disease, and when indicated, tocolysis (prolonging labor) using atosiban is to be maintained for 48 hours.

#### *ii. Route of Delivery-*

Vaginal delivery is the recommended route of delivery for pregnant women with uncomplicated or non-severe cardiac conditions according to all three guidelines. The indications for the caesarean section recommended by the guidelines were also similar: cardiac conditions of the severity of NYHA/WHO classes 3 and 4, severe obstructive cardiac lesions, pulmonary hypertension, including Eisenmenger's syndrome, severe aortic pathologies, acute heart failure, peripartum cardiomyopathy, etc., and among patients on oral anticoagulants.

All three guidelines recommend a lateral decubitus position for delivery. Assisted delivery by shortening the second stage, either by vacuum extraction or forceps, was also recommended.

#### *iii. Maternal Monitoring During Delivery-*

During the delivery of women with cardiac disease, continuous monitoring of maternal BP and heart rate is recommended by all three guidelines. The IPO (ESC) recommends monitoring mothers with heart disease using an arterial line in more severe cases. Continuous monitoring using pulse oximetry and ECG is also recommended by the three guidelines to detect early signs of decompensation and to identify those in whom delivery should be expedited.

Parameters for maternal and fetal monitoring are different for each CVD disease in all three guidelines on CVD in pregnancy. There was a consensus on maternal BP, heart rate, ECG, and pulse oximetry monitoring during the intrapartum period specifically. The IPO (ESC) recommends monitoring using an arterial line for patients with severe heart disease and right atrial pressure monitoring for high-risk patients.

#### **d. Postpartum Care and Long-term Follow-up:**

After delivery, *hemodynamic monitoring* of women with heart disease was recommended, with care in the ICU, CCU, and HDU. While the IPO (ESC) and NPO (BCS Brazil) recommend strict monitoring of 24-48 hours after delivery, the MOH (Malaysia) recommends 24-72 hours of monitoring, depending on the risk.

Considering the risk of complications such as postpartum hemorrhage (PPH), heart failure (HF), and

thrombosis in the immediate postpartum period, all three guidelines recommend specific protocols in the care of women with heart disease who have delivered. *Oxytocin and misoprostol* are recommended as the drugs of choice to prevent PPH, while *thromboprophylaxis* using UFH or LMWH and meticulous leg care along with early ambulation are suggested for preventing venous thrombosis.

*Discharge from the hospital and follow-up (short and long-term)* are recommended by MOH (Malaysia) but not by the other two guidelines. MOH (Malaysia) recommends a hospital stay of at least 3-5 days (in the case of pulmonary hypertension, 7-14 days) for women with heart disease who delivered before getting discharged. Post-discharge, follow-up with customized home visits by the health workers and a cardiac review at 6 weeks postpartum are also recommended by MOH (Malaysia).

For cardiovascular disease (CVD) care in pregnancy during postpartum care, the gaps include the absence of specific recommendations regarding monitoring parameters, both facility-based and community-based follow-up plans, and guidance for the postpartum period in two guidelines, IPO (ESC) and NPO (BCS Brazil).

#### *Multispecialty involvement in the care of patients with heart disease in pregnancy:*

All guidelines recognize the need to have a multidisciplinary approach for pregnancy care with cardiovascular disease and recommend specialist care involving cardiologists based on the risk of CVD.

The IPO (ESC) recommends forming a 'pregnancy heart team' for women with moderate/high risk (mWHO II-III, III, and IV) for pre-pregnancy counseling and management during pregnancy and postpartum.

The team members essentially recommended are a cardiologist, an obstetrician, and an anesthetist, with the scope to include additional experts in related specialties. The MOH (Malaysia) recommends specialist care based on the risk assessment of pregnant women with CVD. For WHO and NYHA Risk classes I and II, consultation at the local hospital by a physician or cardiac specialist is recommended and for classes III and IV, care by a multidisciplinary team at a specialist center with expertise in managing high-risk pregnancies is recommended. Concurrently, the NPO (BCS Brazil) recommends that from the preconception stage until the postpartum period, women with heart disease should be cared for by a multidisciplinary team, with regular consultations with a cardiologist.

### ***3.5.3. Patient Education, Patient Involvement, and Community Engagement:***

Preconception counseling is recommended for women with existing CVD or who had episodes of preeclampsia during previous pregnancies to prepare and educate patients. It includes an assessment of risks, discussion on conception or contraception based on the risks involved, preventive strategies involving lifestyle modifications, diet and education of the family and community regarding warning signs and red flags. The same approach extending to the antenatal period, once the women get pregnant or for newly diagnosed pregnant women, is recommended by the WHO, IPO (ISSHP), MOH (South Africa), and NPO (SOGP Pakistan). The IPO (ESC) does not mention patient counseling or education in the postpartum or longer follow-up period, but all the other six guidelines recommend it. The IPO (ISSHP) recommends community involvement in the care of pregnant women with CVD, especially in low-resource settings. It recommends developing community support for monitoring BP in the community, recognizing warning signs, and providing referral support. None of the six guidelines recommend this.

The inadequacy of patient education and the limited involvement of patients and their families in decision-making processes are prominent deficiencies observed in guidelines on CVD in pregnancy. Additionally, the absence of specific themes for discussion during counseling and education, except for the NPO (SOGP Pakistan) guideline, also presents a prominent gap.

## 4. Discussion and Recommendations

Clinical guidelines are essential for standardizing service delivery and quality of care. This review highlights the limited number of clinical guidelines available for cardiovascular disorders during pregnancy to support clinical care in low-and middle-income countries. We highlight important similarities and differences between these guidelines. Notably, only three guidelines addressing cardiac disorders of pregnancy (excluding HDP) were identified, with only one national professional organization (BCS Brazil) providing guidance for clinicians in this area. We did not identify any health policies that specifically considered the needs of women with CVD during pregnancy.

Clinical guidelines alone, however, are not enough to ensure all women have access to high-quality care for CVD before, during, and after pregnancy. In addition to a lack of information around implementation considerations, absent from these documents were wider considerations of the health system components needed to deliver equitable and quality care. The WHO Health Systems Building Blocks provide a framework for designing health systems and measuring performance.

**The WHO disaggregates health systems into six core components:**



The focus of the clinical guidelines in this report is on the content of service delivery. For most of the national level guidelines (except those of MOH Malaysia and South Africa) there is little consideration of the practical health system requirements to deliver the care described. While health system issues around delivering quality care to women with CVD in pregnancy will overlap with those for general maternity service provision, there are several areas of difference where specific policy recommendations could save lives.

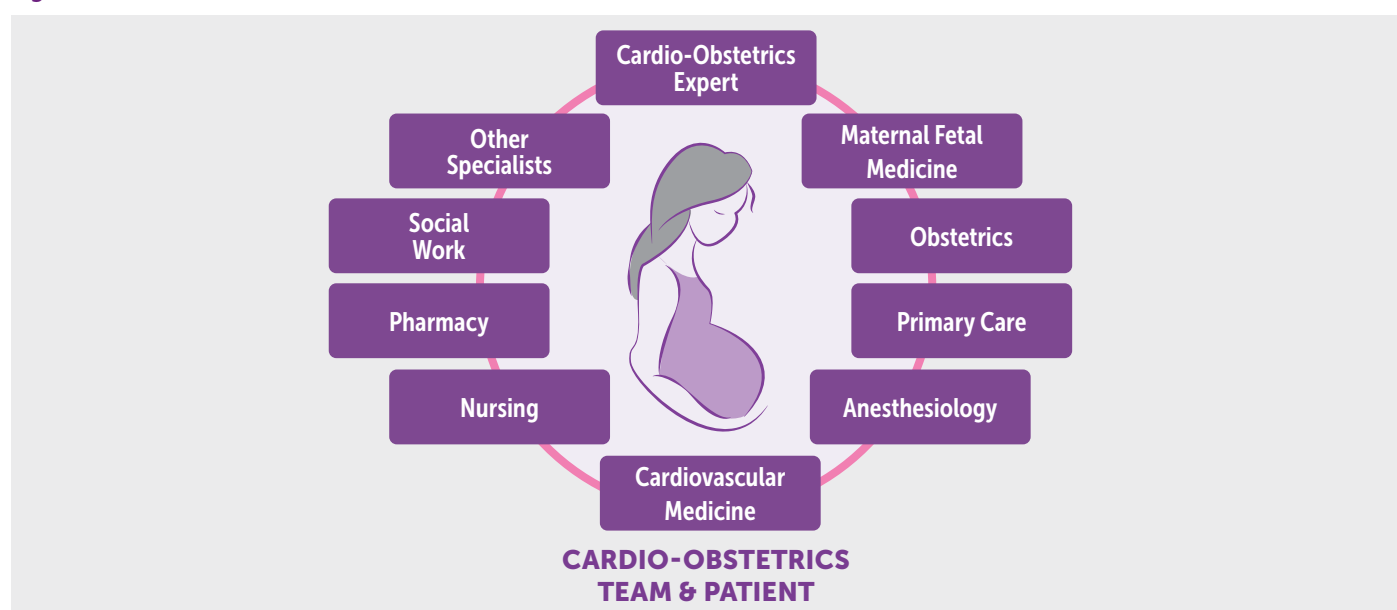
**1. Leadership and governance:** Ensuring that CVD in pregnancy receives investment and policy attention requires leadership from clinicians, patients, the academic community, and NGOs. An example of successful and sustained efforts to achieve change in maternity policies worldwide can be seen in the campaigns to end preventable mortality from postpartum hemorrhage. The PPH community developed a care bundle, comprising care quality and health system elements as well as timely access to essential medicines. This was tested in a large cluster trial and demonstrated to reduce mortality (31). A similar effort to unify the CVD and pregnancy communities is needed.

**2. Health workforce:** Delivery of complex cardiac care requires collaboration between obstetricians, cardiologists, cardiothoracic surgeons, anaesthetists, specialist midwives and nurses and other paramedical professionals (Fig.4). This level of care will usually be available only in secondary or tertiary facilities. Ensuring that the appropriate teams available and accessible to pregnant women with CVD is essential. The role of community health workers, midwives, and other doctors is also important in recognizing women at risk and referring them to appropriate care.

The majority of guidelines fail to specify the categories of clinicians or health providers as their target audience, resulting in a lack of tailored recommendations aligned with the unique skills and expertise of each professional at each level of care. This omission undermines the optimization of healthcare delivery, as specific guidance tailored to the capabilities of individual clinicians is crucial for enhancing overall care for CVD in pregnancy. While most of the guidelines address specialists such as obstetricians, gynaecologists or cardiologists, primary care providers such as community health workers, nurses, and midwives are often overlooked and inadequately addressed. Early identification and intervention by primary care providers can contribute to reducing the risk of future cardiovascular disease (27). This calls for an integrated care model at all levels of health care through a team-based, multidisciplinary approach for caring pregnant women with CVD (28), to be developed through capacity building and upskilling the health workforce(29).



Fig.4. Cardio Obstetric Team. Credits: Davis et al. (2021) (29)



**3. Access to essential medicines:** There are wide variations in the medication regimen for CVD in pregnancy across the available guidelines. Often, the recommended medications are seldom available in the region, hindering their access for pregnant women with CVD. It is further complicated by the absence of financial protection mechanisms and the high cost of medications, which push pregnant women to pay out-of-pocket for CVD care (30) improving medication supply, assuring medicine quality, promoting appropriate use, and managing intellectual property issues. Using key evidence in published and grey literature and systematic reviews, we summarize advances in access to cardiovascular medicines using the five health system dimensions of access: availability, affordability, accessibility, acceptability and quality of medicines. There are multiple barriers to access of cardiovascular disease medicines, particularly in low- and middle-income countries. Low availability of CVD medicines has been reported in public and private health care facilities. Where patients lack insurance and pay out-of-pocket to purchase medicines, they can be unaffordable. Accessibility and acceptability are low for medicines used in secondary prevention; increasing use is positively related to country income. Fixed-dose combinations (FDC. Medications for hypertensive disorders of pregnancy, including magnesium sulfate, are included on the WHO Essential Medicines list under cardiovascular medications.

However, low-molecular weight heparins are not. Policy actions should ensure that supply chains and access to all essential medicines for CVD care are available for all women who need these medications.

**4. Service delivery:** Existing guidelines primarily emphasize cardiovascular care during the antenatal period, neglecting crucial considerations in both pre-pregnancy and post-pregnancy stages, resulting in a fragmented care continuum. Addressing the cardiovascular care needs of pregnant women throughout and after pregnancy necessitates integrating CVD care into existing maternal health services and ensuring affordability through financial protection services.

Several inconsistencies exist among the guidelines regarding specific recommendations for CVD care delivery in pregnancy. There should be harmonization of clinical guidelines based on the current best evidence. In addition, issues around the translations of the guidelines into clinical practice need to be explicitly considered in each health system. The more removed the guideline writing group is from the population where it is to be used (e.g., authors from high-income countries writing about solutions for LMICs), the less practical considerations there are for implementation. Policies should support continuous medical education (including online learning and credentialing) to ensure that practitioners are aware of the guidelines and recommendations.



Existing gaps in the guidelines and recommendations are summarized in the table.4.1. below.

**Table.4. Health system perspective on the gaps found among the guidelines and recommendations to address them**

Health System Building Blocks*	Gaps found	Way Forward
Leadership and Governance	<ul style="list-style-type: none"> <li>• Lack of policies on CVD in pregnancy</li> <li>• Skewed focus on HDP (especially Preeclampsia)</li> </ul>	<ul style="list-style-type: none"> <li>• Ensure that comprehensive care of CVD in pregnancy receives investment and policy attention.</li> <li>• Enhance local capacity by strengthening community level governance and leadership</li> </ul>
Health workforce	<ul style="list-style-type: none"> <li>• Existing recommendations not tailored for various categories of clinicians / health providers</li> <li>• Focus on specialist care and absence of integration into primary care</li> </ul>	<ul style="list-style-type: none"> <li>• Ensure that appropriate guidance is made available and accessible to all categories of health professionals</li> </ul>
Access to essential medicines	<ul style="list-style-type: none"> <li>• Inconsistencies among the guidelines regarding recommendations for medications (Indications, dosage, time of administration etc.)</li> </ul>	<ul style="list-style-type: none"> <li>• Global collaboration to review the existing guidelines and evidence to standardise recommendations on medication regimes and regularly update them</li> </ul>
Service delivery	<ul style="list-style-type: none"> <li>• Fragmented care continuum for pregnant women with CVD</li> <li>• Inconsistencies in the recommendations of CVD care service delivery</li> </ul>	<ul style="list-style-type: none"> <li>• Harmonization of clinical guidelines based on current best evidence.</li> <li>• Ensure holistic, seamless care for all pregnant women with CVD from pre-conception till postpartum stages</li> </ul>

\*the building blocks- Financing and Health information systems are excluded since they are outside the scope of this review on guidelines.

## Limitations

In this review, the decision to exclude non-English language guidelines, excluding Chinese, French, and Spanish was made based on the expense and complexity of translating and synthesizing these guidelines. This might have limited the findings of the review since many guidelines in LMICs might be available in the local language. Additionally, we limited our consideration to guidelines published after 2011, excluding those before this timeframe, to ensure the relevance of the selected guidelines. Furthermore, we specifically included standalone guidelines focusing on cardiovascular disease during pregnancy, but it's possible that we overlooked recommendations mentioned in broader antenatal and maternal care guidelines worldwide. Also, we might have missed any encompassing unpublished policies or guidelines that may not be accessible on the internet. Therefore, this review might have the likelihood of bias.

# 5. Conclusion

CVD care during pregnancy is crucial for reducing maternal morbidity and mortality. This review has been able to identify and describe various guidelines for managing CVD in pregnancy. However, there is a need to address the gaps in terms of availability and access to the policies and guidelines in low-middle income countries (LMIC), along with concerted efforts to ensure standardized and comprehensive care for CVD in pregnancy. The mapping of guidelines and policies on CVD in pregnancy will aid policymakers, public health advocacy groups, academicians, and clinicians to understand the current landscape of CVD care in pregnancy in the LMICs and initiate deliberations in order to progress towards universal and comprehensive CVD care in pregnancy.

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## 6. References

- Nair M, Nelson-Piercy C, Knight M. Indirect maternal deaths: UK and global perspectives. *Obstet Med*. 2017 Mar;10(1):10–5.
- Storm F, Agampodi S, Eddleston M, Sørensen JB, Konradsen F, Rheinländer T. Indirect causes of maternal death. *The Lancet Global Health*. 2014 Oct 1;2(10):e566.
- Goldstein SA, Ward CC. Congenital and Acquired Valvular Heart Disease in Pregnancy. *Curr Cardiol Rep*. 2017 Aug 24;19(10):96.
- Elkayam U, Goland S, Pieper PG, Silverside CK. High-Risk Cardiac Disease in Pregnancy: Part I. *J Am Coll Cardiol*. 2016 Jul 26;68(4):396–410.
- Silversides CK, Grewal J, Mason J, Sermer M, Kiess M, Rychel V, et al. Pregnancy Outcomes in Women With Heart Disease: The CARPREG II Study. *J Am Coll Cardiol*. 2018 May 29;71(21):2419–30.
- World Health Organisation. World Health Organisation. 2023 [cited 2023 Nov 16]. Maternal mortality. Available from: [www.who.int/news-room/fact-sheets/detail/maternal-mortality](http://www.who.int/news-room/fact-sheets/detail/maternal-mortality)
- Kotit S, Yacoub M. Cardiovascular adverse events in pregnancy: A global perspective. *Glob Cardiol Sci Pract*. 2021(1):e202105.
- Roth GA, Mensah GA, Johnson CO, Addolorato G, Ammirati E, Baddour LM, et al. Global Burden of Cardiovascular Diseases and Risk Factors, 1990–2019. *Journal of the American College of Cardiology*. 2020 Dec 22;76(25):2982–3021.
- Hettiarachchi A, Jayaratne K, Silva CD, Senanayake H, Lokunarangoda N, Agampodi S. Heart disease complicating pregnancy as a leading cause of maternal deaths in LMIC settings: the Sri Lankan experience. *The Lancet Regional Health - Southeast Asia* [Internet]. 2023 Aug 1 [cited 2023 Jul 27];15. Available from: [www.thelancet.com/journals/lansea/article/PIIS2772-3682\(23\)00083-5/fulltext#secsectitle0105](http://www.thelancet.com/journals/lansea/article/PIIS2772-3682(23)00083-5/fulltext#secsectitle0105)
- Lumsden R, Barasa F, Park LP, Ochieng CB, Alera JM, Millar HC, et al. High Burden of Cardiac Disease in Pregnancy at a National Referral Hospital in Western Kenya. *gh*. 2020 Feb 7;15(1):10.
- Sliwa K, Böhm M. Incidence and prevalence of pregnancy-related heart disease. *Cardiovasc Res*. 2014 Mar 15;101(4):554–60.
- Peters MDJ, Godfrey CM, Khalil H, McInerney P, Parker D, Soares CB. Guidance for conducting systematic scoping reviews. *JBIM Evidence Implementation*. 2015 Sep;13(3):141–6.
- The World Bank. The World Bank. 2022 [cited 2022 Dec 19]. World Bank Country and Lending Groups – World Bank Data Help Desk. Available from: [www.datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups](http://www.datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups)
- WHO. WHO recommendation on Calcium supplementation before pregnancy for the prevention of pre-eclampsia and its complications [Internet]. World Health Organization; 2020. Available from: <https://www.who.int/publications/i/item/9789240003118>
- WHO. WHO recommendation on Calcium supplementation during pregnancy for the prevention of pre-eclampsia and its complications [Internet]. World Health Organization; 2018. Available from: [www.apps.who.int/iris/bitstream/handle/10665/277235/9789241550451-eng.pdf?ua=1](http://www.apps.who.int/iris/bitstream/handle/10665/277235/9789241550451-eng.pdf?ua=1)
- World Health Organization. WHO recommendations on antiplatelet agents for the prevention of pre-eclampsia. World Health Organization; 2021.
- World Health Organization. WHO recommendations for prevention and treatment of pre-eclampsia and eclampsia [Internet]. Geneva: World Health Organization; 2011 [cited 2023 Nov 7]. Available from: <https://iris.who.int/handle/10665/44703>
- WHO. WHO recommendations on Policy of interventionist versus expectant management of severe pre-eclampsia before term [Internet]. World Health Organization; 2018. Available from: [www.who.int/publications/i/item/9789241550444](http://www.who.int/publications/i/item/9789241550444)
- WHO. WHO recommendations on drug treatment for non-severe hypertension in pregnancy [Internet]. World Health Organization; 2020. Available from: [www.who.int/publications/i/item/9789240008793](http://www.who.int/publications/i/item/9789240008793)
- WHO. WHO recommendations on drug treatment for severe hypertension in pregnancy [Internet]. World Health Organization; 2018. Available from: [www.apps.who.int/iris/bitstream/handle/10665/277234/9789241550437-eng.pdf?ua=1](http://www.apps.who.int/iris/bitstream/handle/10665/277234/9789241550437-eng.pdf?ua=1)
- Ministry of Health Malaysia, Academy of Medicine Malaysia, National Heart Association of Malaysia. Clinical Practice Guideline Heart Disease in Pregnancy 2nd edition [Internet]. Ministry of Health Malaysia; 2016. Available from: [www.moh.gov.my/moh/resources/Penerbitan/CPG/CARDIOVASCULAR/7.pdf](http://www.moh.gov.my/moh/resources/Penerbitan/CPG/CARDIOVASCULAR/7.pdf)
- Moodley J, Soma-Pillay P, Buchmann E, Pattinson RC. Hypertensive disorders in pregnancy: 2019 National guideline. *South African Medical Journal* [Internet]. 2019 Sep 13 [cited 2023 Jan 30];109(9). Available from: [www.samj.org.za/index.php/samj/article/view/12723](http://www.samj.org.za/index.php/samj/article/view/12723)
- Baqai SM, Rahim R, Ala H, Tarar SH, Waqar F, Yasmeen H, et al. Society of Obstetricians and Gynaecologists Pakistan (SOGP) Hypertensive Disorders in Pregnancy Guidelines- 2022. *Pakistan Armed Forces Medical Journal*. 2022 Jun 21;72(3):731–53.
- De Silva PHP, Lanerolle S, Dodampahala SH, Silva R, Mathota C. Hypertensive disorders of pregnancy. *Sri Lanka J Obstet & Gynae*. 2022 Jun 16;44(1):65.
- Regitz-Zagrosek V, Roos-Hesselink JW, Bauersachs J, Blomström-Lundqvist C, Cifková R, De Bonis M, et al. 2018 ESC Guidelines for the management of cardiovascular diseases during pregnancy: The Task Force for the Management of Cardiovascular Diseases during Pregnancy of the European Society of Cardiology (ESC). *European Heart Journal*. 2018 Sep 7;39(34):3165–241.
- Avila WS, Alexandre ERG, Castro ML de, Lucena AJG de, Marques-Santos C, Freire CMV, et al. Brazilian Cardiology Society Statement for Management of Pregnancy and Family Planning in Women with Heart Disease - 2020. *Arq Bras Cardiol*. 2020 Jun 1;114(5):849–942.
- Graves M, Howse K, Pudwell J, Smith GN. Pregnancy-related cardiovascular risk indicators: Primary care approach to postpartum management and prevention of future disease. *Can Fam Physician*. 2019 Dec;65(12):883–9.
- Davis MB, Arendt K, Bello NA, Brown H, Briller J, Epps K, et al. Team-Based Care of Women With Cardiovascular Disease From Pre-Conception Through Pregnancy and Postpartum. *J Am Coll Cardiol*. 2021 Apr 13;77(14):1763–77.
- Sharma G, Zakaria S, Michos ED, Bhatt AB, Lundberg GP, Florio KL, et al. Improving Cardiovascular Workforce Competencies in Cardio-Obstetrics: Current Challenges and Future Directions. *J Am Heart Assoc*. 2020 Jun 2;9(12):e015569.
- Wirtz VJ, Kaplan WA, Kwan GF, Laing RO. Access to Medications for Cardiovascular Diseases in Low- and Middle-Income Countries. *Circulation*. 2016 May 24;133(21):2076–85.
- Gallos I, Devall A, Martin J, Middleton L, Beeson L, Galadanci H, et al. Randomized Trial of Early Detection and Treatment of Postpartum Hemorrhage. *New England Journal of Medicine*. 2023 Jul 6;389(1):11–21.

## 7. ANNEXURES

### Annexure.1

Search strategy- A full search strategy for at least one electronic database- PubMed

*The search strategy consisted of search terms for:*

- i. concerned populations such as 'pregnant', 'women', 'antenatal', 'peripartum', 'postpartum', 'gestational' etc
- ii. Effects of interest such as 'cardiovascular diseases', 'heart diseases', 'non-communicable diseases', 'coronary artery disease', 'coronary heart disease', 'cerebrovascular disease', 'stroke', 'aortic atherosclerosis', 'hypertension', 'eclampsia', 'pre-eclampsia', 'valvular heart disease', 'arrhythmia', 'cardiomyopathy', 'heart failure', 'ischaemic heart disease' etc.

- iii. intervention(s) evaluated such as 'diagnosis', 'screening', 'identification', 'management', 'intervention', 'treatment', 'prognosis', 'rehabilitation', 'surveillance' etc

- iv. types of evidence such as 'policy', 'guidelines', 'manual', 'recommendations' etc.

The terms were combined with the Boolean Operators OR and AND in various permutations and combinations (i, ii, and iii separately) to reach conceptual clarity. These concepts were again combined using the Boolean Operator AND to get the final results.

A reference list of reports and citations of journal articles was also carried out (forward and backward search) to include all the relevant literature.

### Annexure.2- List of Guidelines on Cardiovascular Diseases in Pregnancy included in the scoping review

Title of the Guideline	Publisher	Country/ Region	Year of publication	CVD conditions	Target population	
					Pregnant women	Health provider
Clinical Practice Guideline- Heart Disease in Pregnancy	Ministry of Health, Malaysia, Academy of Medicine, Malaysia and National Heart Association of Malaysia	Upper middle income	2016	Valvular Heart Disease, Cardiomyopathy, Arrhythmia, Other structural abnormalities, Coronary Artery Disease, Hypertension, Eclampsia, Pre eclampsia,	Women with cardiac disease planning for pregnancy and pregnant women with underlying cardiac disease	primary care physicians, obstetricians/ gynaecologists, cardiologists/ surgeons,
The hypertensive disorders of pregnancy: ISSHP classification, diagnosis & management recommendations for international practice	International Society for the Study of Hypertension in Pregnancy (ISSHP)	Global/ Regional	2018	Hypertension, Eclampsia, Pre eclampsia,	The target population is not specified in the document, though it include all pregnant women during pregnancy, delivery and after delivery	All clinicians
2018 ESC Guidelines for the management of cardiovascular diseases during pregnancy	The Task Force for the Management of Cardiovascular Diseases during Pregnancy of the European Society of Cardiology (ESC)	Global/ Regional	2018	Valvular Heart Disease, Cardiomyopathy, Arrhythmia, Other structural abnormalities, Coronary Artery Disease, Ischaemic Heart Disease, Hypertension, Eclampsia, Pre eclampsia	All pregnant women already diagnosed or newly diagnosed with CVD.	Not specified as target audience, though elsewhere mentioned addressing all health staff who are involved in specialty care of pregnant women with CVD

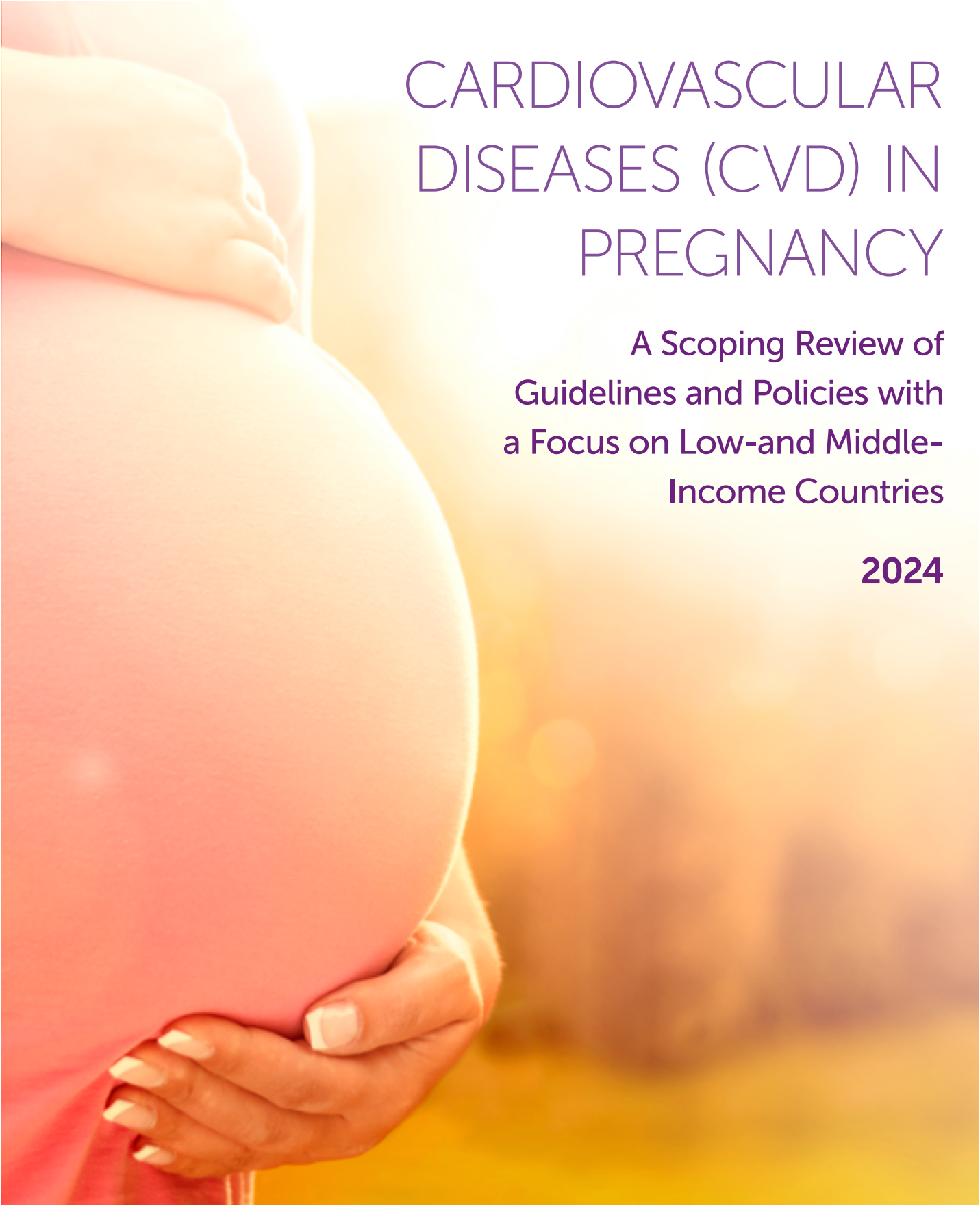
Title of the Guideline	Publisher	Country/ Region	Year of publication	CVD conditions	Target population	
					Pregnant women	Health provider
The International Federation of Gynecology and Obstetrics (FIGO) initiative on pre-eclampsia: A pragmatic guide for first-trimester screening and prevention	International Federation of Gynecology and Obstetrics	Global/ Regional	2019	Hypertension, Pre eclampsia	Women at the 1st trimester of pregnancy, with or without diagnosed as having Pre eclampsia	Healthcare providers such as community health workers, midwives/ nurses, primary care physicians, obstetricians/ gynaecologists,
Hypertensive disorders in pregnancy: 2019 National guideline	Ministerial National Committee on Confidential Enquiries into Maternal Deaths in South Africa.	Upper middle income	2019	Hypertension, Eclampsia, Pre eclampsia	The target population is pregnant women with hypertension at every level of care.	Healthcare professionals
WHO recommendations on drug treatment for non-severe hypertension in pregnancy	The World Health Organization	Global/ Regional	2020	Hypertension, Eclampsia, Pre eclampsia	pregnant women in low-, middle- or high income settings, particularly those who experience non-severe hypertension during pregnancy.	midwives/ nurses, primary care physicians, obstetricians/ gynaecologists, Healthcare providers, managers of maternal and child health programmes, and relevant staff in ministries of health
WHO recommendations Drug treatment for severe hypertension in pregnancy	The World Health Organization	Global/ Regional	2020	Hypertension, Eclampsia, Pre eclampsia	The population affected by the recommendations includes pregnant women in low-, middle- or high-income settings, particularly those who experience severe hypertension during pregnancy.	midwives/ nurses, primary care physicians, obstetricians/ gynaecologists, Healthcare providers, Managers, relevant ministry staff

Title of the Guideline	Publisher	Country/ Region	Year of publication	CVD conditions	Target population	
					Pregnant women	Health provider
WHO recommendation on Calcium supplementation before pregnancy for the prevention of pre-eclampsia and its complications	The World Health Organization	Global/ Regional	2018	Pre eclampsia	The population affected by this recommendation includes women (particularly those intending to become pregnant and those women at higher risk of gestational hypertensive disorders) in low, middle or high-income settings	midwives/ nurses, primary care physicians, obstetricians/ gynaecologists, health professionals, program managers, ministry staff
WHO recommendation Calcium supplementation during pregnancy for the prevention of pre-eclampsia and its complications	The World Health Organization	Global/ Regional	2020	Eclampsia, Pre eclampsia	The population affected by this recommendation includes all pregnant women (particularly those at higher risk of gestational hypertensive disorders) in low-, middle- or high-income settings, and those living in areas where dietary intake of calcium is low	midwives/ nurses, primary care physicians, obstetricians/ gynaecologists, health professionals, program managers, ministry staff
WHO recommendations Policy of interventionist versus expectant management of severe pre-eclampsia before term	The World Health Organization	Global/ Regional	2018	Pre eclampsia	The population affected by the recommendations includes pregnant women in low-, middle or high-income settings, particularly those who experience severe pre-eclampsia during pregnancy.	midwives/ nurses, primary care physicians, obstetricians/ gynaecologists, health professionals, managers, ministry staff
WHO recommendations for Prevention and treatment of pre-eclampsia and eclampsia	The World Health Organization	Global/ Regional	2011	Pre eclampsia	The population affected by the recommendations includes pregnant women in low-, middle or high-income settings, particularly those who experience severe pre-eclampsia during pregnancy.	midwives/ nurses, primary care physicians, obstetricians/ gynaecologists, health professionals, managers, ministry staff



Title of the Guideline	Publisher	Country/ Region	Year of publication	CVD conditions	Target population	
					Pregnant women	Health provider
WHO recommendations on antiplatelet agents for the prevention of pre-eclampsia	The World Health Organization	Global/ Regional	2021	Pre eclampsia	The population affected by the recommendations includes pregnant women in low-, middle or high-income settings, particularly those who experience severe pre-eclampsia during pregnancy.	midwives/ nurses, primary care physicians, obstetricians/ gynaecologists, health professionals, managers, ministry staff
Hypertensive disorders of pregnancy	Sri Lanka College of Obstetricians and Gynaecologists (SLCOG)	Lower middle income	2022	Hypertension, Eclampsia, Pre eclampsia	Not stated specifically, though women before and during pregnancy & during and after delivery are targeted at each stage	Not specified
Society of Obstetricians and Gynaecologists Pakistan (SOGP) Hypertensive Disorders in Pregnancy Guidelines- 2022	Society of Obstetricians and Gynaecologists Pakistan (SOGP)	Lower middle income	2022	Hypertension, Eclampsia, Pre eclampsia	Not stated though women intending to become pregnant, pregnant women during antenatal period, during delivery and after delivery are considered	All health professionals
Diagnosis and treatment of hypertension and pre-eclampsia in pregnancy: a clinical practice guideline in China 2020	Chinese Society of Obstetrics and Gynecology, Chinese Medical Association	Upper middle income	2020	Chronic hypertension	Women with underlying cardiovascular diseases or medical conditions; women with previous history of preeclampsia, multiple pregnancy	All clinicians
Brazilian Cardiology Society Statement for Management of Pregnancy and Family Planning in Women with Heart Disease – 2020	Brazilian Cardiology Society	Upper middle income	2020	Congenital Heart Disease, Valvular Heart Disease, cardiomyopathy, Ischemic Heart Disease, Pulmonary HTN, Aortic HTN, Arrhythmia, Pulmonary HTN, Aortic Disease, Hypertensive Diseases in Pregnancy, Heart Failure	Pregnant women with heart disease	Not specified

Title of the Guideline	Publisher	Country/ Region	Year of publication	CVD conditions	Target population	
					Pregnant women	Health provider
Guía de práctica clínica para la prevención y el manejo de la enfermedad hipertensiva del embarazo- Clinical practice guideline for the prevention and management of hypertensive disorders of pregnancy	Social Health Security (EsSalud) of Peru	Upper middle income	2022	Hypertension, Eclampsia, Pre eclampsia	The target population of the guide are pregnant women at risk of developing or diagnosed with EHE, preeclampsia and severe preeclampsia.	clinicians at all levels of care providing care for pregnant women



# CARDIOVASCULAR DISEASES (CVD) IN PREGNANCY

A Scoping Review of  
Guidelines and Policies with  
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Income Countries

**2024**

Report Prepared by



On behalf of



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