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# A Review on Hypertension: Practice and Diagnosis

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**Abstract**

Among various reasons of raised hypertension, excessive blood pressure is the major one. Hypertension affects over a billion people worldwide, especially the elder people. The International Society of Hypertension (ISH) has extensively developed the practice guidelines to reduce the extent of hypertension caused by high blood pressure (BP) with evidence-based contents for adults, expecting wide range of accessibility and applicability by the physicians from low to high resource settings inclusively. Optimal care defines the evidence-based standard of care while the essential standard refers to the principles of care allowing specification for the deprived settings only. However, the specific portion of this study required to take experts' opinion when there was a limitation to evidence for undertaking the assessments. This paper evaluates the ways in which we can diagnose hypertension in patients and evaluate the preventive measures and treatment options through lifestyle changes and pharmacological treatments.

**Keywords:** hypertension, blood pressure, heart disease, antihypertensive therapy

## 1. Introduction

Higher blood pressure (BP) level has been the main reason for death across the world, with an estimated 10 million deaths a year (Stanaway et al., 2018). In 2010, a study was conducted to estimate the statistical viewpoint of hypertension which found out that globally almost one and a half billion people were suffering from hypertension at that time with 517,000 people in the United States passing away from hypertension in 2019 (Stanaway et al., 2018; Mills et al., 2015; Zhou et al. 2017). The trends in blood pressure show a visible spike in the highest BPs across the developed to the deprived regions (Mills et al., 2015). Almost 1.04 billion people are suffering from hypertension in low and lower middle-income countries, where in the high-income countries, the number is around 350 million (Zhou et al. 2017). The key reasons for the excessive hypertension rate are mainly the challenges in treatment protocols, lack of awareness and control rates across low-middle to higher resource countries. A campaign named the May Measurement Month (3M) was introduced and run to help battle the challenging awareness conditions for hypertension across the world. Around 67% of people across the developed and 38% of people across the low and middle-income countries lack proper awareness as to stay fit from hypertension (Beaney et al., 2019; Beaney et al., 2018).

Ever since the ISH published Clinical Practice Guidelines in 2014 in collaboration with the American Society of Hypertension, a flurry has been observed of the evidence-based guidelines. Their suggestions included and promoted redefining hypertension by taking medics of a pill with combined therapy and advised out-of-office BP measurement for quite minimal BP targets. However, middle and low-income countries used to follow and share guidelines that were designed for the developed countries as well. The crucial challenge for them was associated with the resources that lowered the practical applications of the suggested guidelines to a great extent. Across the African regions, only one-fourth of the countries have been identified with having proper hypertension guidelines to follow which was more likely made following the ones prepared for the high income or developed countries (Dzudie et al., 2018). That resulted in highly impractical due to several challenges. Despite the countries, the guidelines have been circulated, they are applied confusingly among healthcare providers, which resulted in global harmonization causing the guidelines from high-income not to serve global purposes adequately (Messerli et al., 2018; Rehan et al., 2017; Poulter et al., 2018).

*Guideline Development Process:*

Based on the following criteria, the ISH Hypertension Guidelines Committee developed the 2020 ISH Global Hypertension Practice Guidelines without any support from any sources.

(1) to be suitable for utilization globally;

(2) to be applied worldwide; and

(3) to be clarified, precise, and applicable.

## 2. Hypertension: Types and Categories

Clinical guidelines suggest that hypertension is diagnosed when the diastolic blood pressure (DBP) of the subject is equal or greater than (≥) 90 mm Hg and/or their systolic blood pressure (SBP) in the clinic or office is equal or greater than (≥) 140 mm Hg. The range has been derived through repeated clinical trials. However, the blood pressure is considered normal when DBP is around 80 mm Hg and SBP is likely 120 mm Hg.

The following Table 1 depicts a classification of BP measuring from the subjects at the office environment, and Table 2 provides values while being at home.

- *High-normal BP:* Identify subjects benefitting from lifestyle interventions and allowed to receive treatment.
- *Isolated systolic hypertension:* Low DBP (<90 mm Hg) and raised SBP (≥140 mm Hg) is regular among adult and especially juvenile individuals.
- Subjects having been diagnosed with hypertension are advised to take treatment.

Table 1. Categorization of Hypertension According to the Office Blood Pressure (BP) Measurement

| Class | DBP (mm Hg) | | **SBP (mm Hg)** |
|---|---|---|---|
| Normal BP | <85 | And | **<130** |
| High-normal BP | 85–89 | and/or | **130–139** |
| Grade 1 hypertension | **90-99** | and/or | 140–159 |
| Grade 2 hypertension | ≥100 | and/or | **≥160** |

Table 2. Classification of Hypertension Based on Ambulatory blood pressure Measurement (ABPM), Office BP and Home Blood Pressure Measurement (HBPM)

| Class | **SBP/DBP, mm Hg** |
|---|---|
| **1. ABPM** | |
| **• 24-hour average** | **≥130 and/or ≥80** |
| **• Day-time average** | **average ≥135 and/or ≥85** |
| **• Night-time average** | **≥120 and/or ≥70** |
| **2. Office BP** | ≥140 and/or ≥90 |
| **3. HBPM** | ≥135 and/or ≥85 |

## 3. Hypertension Diagnosis by Measurement of Blood Pressure

### *3.1 Diagnosis of Hypertension by measurement of Office Blood Pressure*

#### 3.1.1 Essential Approach

- Office or clinic BP measurement is the most common diagnostic tool. The recommendations to measure office BP is described in Table 3 and illustrated in Figure 1 (Williams et al., 2018; Muntner et al., 2019).
- The diagnosis is not recommended by measuring the BP on a single office visit. With 1-4-week interval, multiple visits are required in this purpose. The exception is for BP ≥180/110 mm Hg with cardiovascular disease (CVD) (Williams et al., 2018; Muntner et al., 2019).
- Table 3 shows the recommended patient management as per BP levels (office). However, the diagnosis of hypertension may be addressed in an off-office environment also (Williams et al., 2018; Whelton et al., 2018; O'Brien et al., 2013; Kario et al., 2019).

Table 3. Guidance for Office BP Measurement

| | ***Instructions*** |
|---|---|
| **Conditions** | • Silent room condition with comfortable and suitable temperature.<br>• Some instructions are followed before taking the measurements.<br>1. Avoiding smoking and caffeine is necessary.<br>2. Short-time exercise for 30 minutes.<br>3. Keeping the bladder empty.<br>4. Remaining seated comfortably for 3–5 min.<br>• It is prohibited to talk or make sound before, during or after taking measurements. |
| **Posture** | • Sitting on a chair as the arms are kept on resting on a table and mid-arm remain at the heart level;<br>• Back of the person should be supported by a chair;<br>• The legs have to kept uncrossed and feet have to stay flat on the floor as illustrated in Fig. 1. |
| **Machine** | • Authentic oscillometric or electronic upper-arm cuff tool. |
| **Cuff** | • Size of the cuff have to be selected based on the arm circumference of individual (larger cuff underestimates and smaller cuff overestimates the bp).<br>• There are two types of cuff devices: manual auscultatory device and electronic device. |

| | |
|---|---|
| | 1. **Manual auscultatory devices:** 75%–100% of the arm circumference of the individual have to be covered by the inflatable bladder of the cuff.<br>2. **Electronic devices:** Based on the instructions, precise cuffs are used. |
| **Steps of the protocol** | 1. 3 consecutive measurements keeping the interval of 1 minute is needed to take at each visit.<br>2. Then average of the bp obtained from the second and third measurements is calculated.<br>3. The latter two measurements have to take if only the BP of the first reading comes above 130/85 mm Hg. |
| **Interpretation** | • Hypertension is diagnosed as bp of 2 to 3 office visits is greater or equal to 140/90 mm Hg. |

3.1.2 Optimal Approach

- **Primary evaluation:** It recommends measuring blood pressure in both arms. Given an identical variation of more than 10 mm Hg is observed between arms. If the variation is >20 mm Hg, the arm having higher bp is used for further study to be done.
- **Standing blood pressure:** Symptoms of hypotension being exposed repeated measurement is recommended in every two minutes interval.
- **Unattended office blood pressure:** While the individual stays alone at the office, automated measurements are taken which can provide a standard but lower than the normal value that accompanies harmonics. Confirmation with off-office BP is required for deciding (Stergiou et al., 2018; Muntner et al., 2019; Stergiou et al., 2018; Myers et al., 2018 ).

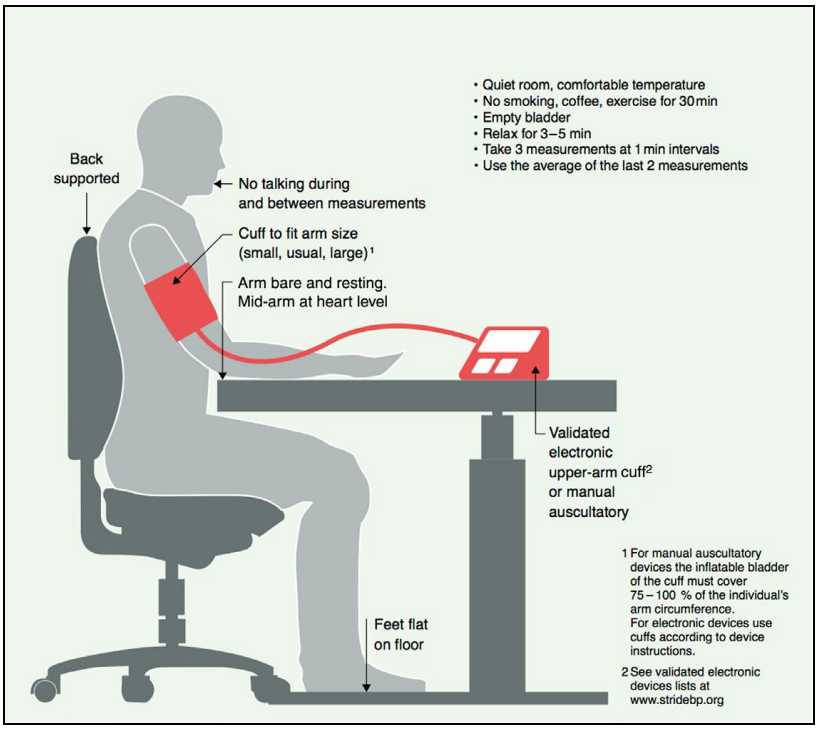


Figure 1. The recommended method of the measurement of bp

*3.2 Masked and White-Coat Hypertension*

The diagnostic measurements taken inside or outside of the office causes hypertension which is correlated with the white coat. It was found to have raised the level of BP around the office environment. Even though the individuals having the masked hypertension experience optimal bp in the office environment, the level of BP increases outside, i.e. ambulatory or home. The untreated treated patients experience the same. It was found that white coat hypertension happened to around 10%–30% of subjects to get them to the physicians because of the higher level of blood pressure whereas only 10%–15% of them was found to be suffered from masked hypertension (Williams et al., 2018; Whelton et al., 2018; Stergiou et al., 2018; Muntner et al., 2019; O'Brien et al., 2013; Parati et al., 2008; Kario et al., 2019; Mancia et al., 2006; Stergiou et al., 2014; Asayama et al., 2014).

3.2.1 Masked Hypertension

Typically, cardiovascular diseases cause this masked hypertension associated with sustained hypertensives. The same repeated diagnosis is applicable for this even though it needs medicine prescription to keep the BP level as optimal as possible in the out-office environment (Williams et al., 2018; Whelton et al., 2018; Stergiou et al., 2018; Muntner et al., 2019; O'Brien et al., 2013; Parati et al., 2008; Kario et al., 2019; Mancia et al., 2006; Stergiou et al., 2014; Asayama et al., 2014).

3.2.2 White Coat Hypertension

They are mostly the patients who have risk factors lying between sustained hypertensives and normotensives. Taking repeated measurements is recommended for the verification at both

the in-office and out-office settings. However, given the inclusive cardiovascular risk being in the minimal range with no HMOD, medicines are not usually prescribed for treatment rather lifestyle modification is suggested.

## 4. Hypertension Risk Factors

### *4.1 Diagnostic Approach*

• Half of the hypertensive patients found to have experienced the hypertension risk factors put it in the list of top risk factors.

• Other additional risk factors are triglycerides which contributes 30% of the total hypertensive patients, diabetes (15%–20%), overweight- obesity (40%), metabolic syndrome (40%), lipid disorders (25%) and, non-healthy daily life habits including high alcohol intake, smoking and sedentary lifestyle.

• An easy-to-use assessment followed by the levels of BP along with the related risk factors proposed by ESCESH Guidelines is shared in Table 4 (Lopez et al., 2006; Tunstall-Pedoel et al., 2004; Neaton et al., 1992).

### *4.2 Additional Risk Factors*

- Sex (male>female)
- Obesity
- Age greater than 65 years
- Diabetes
- Heart rate greater than 80 beats/min
- High LDL-C/triglyceride
- Genetic background with CVD and hypertension
- Socioeconomic or psychosocial factors
- Early-onset menopause
- Smoking
- Elevated serum uric acid
- Chronic inflammatory diseases
- Cardiovascular risk
- Psychiatric disorders
- Psychosocial stressors and
- Chronic obstructive pulmonary disease.

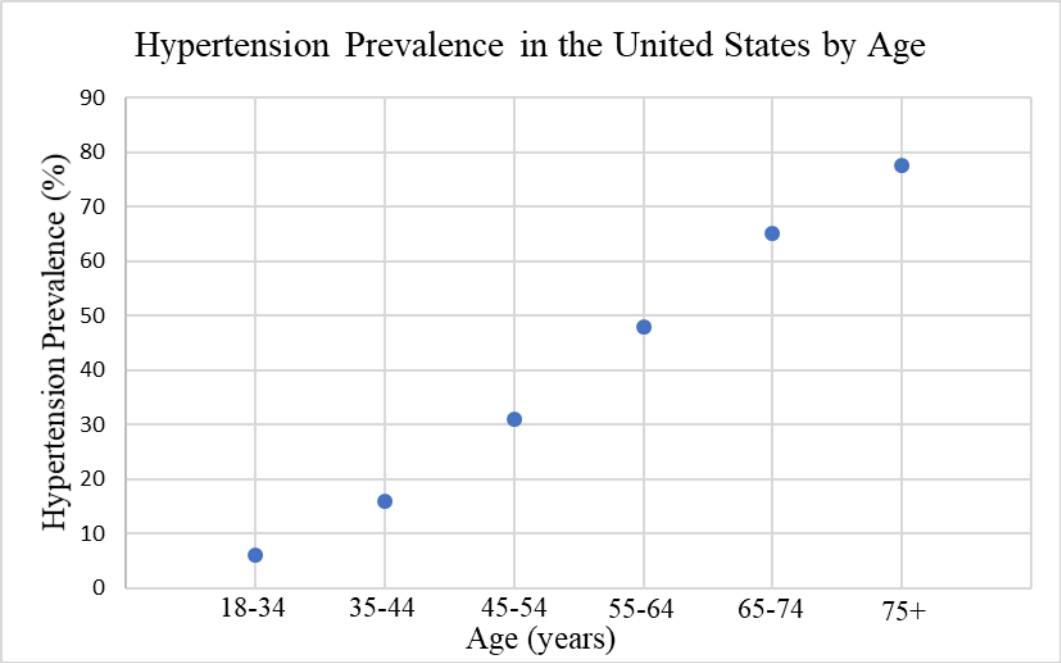


Figure 2. Hypertension prevalence by age in the United States

The graph above shows that as age increases so does the risk of being diagnosed with hypertension. Thus, as age increases one should be more careful and monitor hypertension as onset is higher (Fields et al., 2004).

Table 4. Categorization of risk according to additional risk factors of hypertension, HMOD, and other pre-existing disease

| ***Additional risk factors, HMOD, and other disease*** | ***High-Normal BP [SBP (130−139 mm Hg) and DBP (85−89 mm Hg)*** | ***Grade 1 [DBP (90−99 mm Hg) and SBP (140–159 mm Hg)]*** | ***Grade 2 [DBP ≥100 mm Hg and SBP ≥160 mm Hg]*** | |
|---|---|---|---|---|
| ***No additional risk factors*** | Low | Low | Moderate | High |
| ***One or two risk factors*** | Low | Moderate | High | |
| ***More than 2 risk factors*** | Low / Moderate | High | High | |
| ***HMOD, diabetes mellitus, CKD grade 3, CVD*** | High | High | High | |

## 5. Hypertension-Mediated Organ Damage (HMOD)

### *5.1 Management of Hypertension with HMOD*

The organs that are responsible for the structural variation of the arterial vasculature causing an elevated BP are known as HMOD. The organs that are the parts of it are the heart, the brain, the kidneys, the eyes, and central or peripheral arteries. Cardiovascular risk is essential for hypertension management. HMOD is responsible to provide guidance on the following as to manage hypertension:

a. Because of the existence of HMOD, reclassification is done for the management purpose of hypertensive patients with low or moderate risk factors

b. Selection of preferential drug treatment according to the precise effect on HMOD.

### 5.2. *Particular Features of HMOD and Their Evaluation*

- **Brain**: Brain strokes are one of the common reasons of high BP. MRI can be considered as a diagnosis approach.
- **Heart:** For the individuals manifesting symptoms of hypertension, a 12-lead ECG is suggested.
- **Kidney:** Maybe assessed using renal function parameter given that it's a cause or consequence of high BP.
- **Eyes:** Fundoscopy, a simple bedside diagnosis is recommended.
- **Arteries:** An assessment using 3 vascular beds is suggested to detect arterial HMOD.

## 6. Exacerbators and Inducers of Hypertension

Several therapies may give a boost in increased BP by reducing the impacts of antihypertensive medics in particular subjects. Table 5 below illustrates the influence of the specific drugs.

Table 5. A list of Hypertension Inducers and exacerbators

| *Drugs or other medications* | *Details* |
|---|---|
| **Nonsteroidal anti-inflammatory drugs (NSAIDs)** | • No effective difference of bp or an increment of at most 3/1 mm Hg after consumption of celecoxib.<br>• Nonselective NSAIDs increase bp up to 3/1 mm Hg.<br>• Unchanged effect of aspirin on bp.<br>• Some antagonists like beta-blockers and RAAS-inhibitors can reverse the effect of NSAIDs. |
| **Combined oral contraceptive pill** | High doses of progestin (1-4 mcg) and estrogen (greater than 50 mcg) can increase the bp of the individual up to 6/3 mm Hg. |
| **Anti-depressants** | • Some antidepressants like selective norepinephrine and serotonin reuptake inhibitors (SNRI) can increase the bp of an individual up to 2/1 mm Hg.<br>• Tricyclic antidepressant can increase the hypertension in a ratio of 3.19.<br>• SSRI can't increase the bp. |
| **Acetaminophen** | Daily consumption of acetaminophen, can increase the relative risk of hypertension 1.34 times more. |
| **Other therapeutic drugs or medications** | • Antiretroviral therapy<br>• Steroidal drugs<br>• Sympathomimetics<br>• Antimigraine serotonergic recombinant human erythropoietin<br>Calcineurin inhibitors<br>• Kinase inhibitors and Anti-angiogenesis drugs<br>• 11 s-hydroxysteroid dehydrogenase type 2 inhibitors |
| **Herbal substances** | Ma-huang, alcohol, liquor ice, ginseng at high doses, yohimbine, St. John's wort etc. |

## 7. Treatment of Hypertension

### *7.1 Lifestyle Modifications*

Healthy lifestyles can help to get rid of or make a delay in the onset of high bp and hypertension (Piepoli et al., 2016). This can also take part to lessen the risk or likelihood of onset of cardiovascular diseases. However, the modification in lifestyle and daily habits is considered the most important and the front-line treatment for hypertension which is depicted in Table 6 (V et al., 2013; Gay et al., 2016; Cicero et al., 2019; Xie et al., 2018; Roerecke et al., 2017; Alberti G et al., 2006; Ashwell et al., 2012; Browning et al., 2010; Casonatto et al., 2016; Costa et al., 2018; Cornelissen VA et al., 2013; Cornelissen et al., 2013; Solano López A. L. et al., 2018; Wang et al., 2013; Liwa et al., 2014; Giorgini et al., 2016; Fedak et al 2019).

Table 6. Lifestyle Modifications

| Moderations | Guidelines |
|---|---|
| **Salt reduction** | Increased bp and high salt consumption have a mutual liaison. Less amount of salt and foods containing salt are recommended. |
| **Healthy diet** | Diet with enriched fruits, grains, polyunsaturated fats, dairy products high in sugar, vegetables, saturated fat and trans fats. Vegetables like leafy vegetables and beetroot equipped with nitrates are known to reduce BP. Foods rich with calcium, magnesium and potassium like nuts, avocados, seeds, tofu and legumes are effective. |
| **Drinks** | Limited consumption of black and green tea or coffee and beverages such as pomegranate juice, karkadé (hibiscus) tea, cocoa, beetroot juice etc. |
| **Reduction of alcohol consumption** | Blood pressure, alcohol consumption, CVD risk and the onset of hypertension are found to be proportionally related.10 g alcohol/ standard drink are recommended (1.5 standard drinks for women and 2 for men) while avoiding binge drinking. |
| **Weight control** | Abdominal obesity has to be taken care of since weight control is linked to keeping obesity in balance. A waist-to-height ratio should be kept less than 1:2 for all. |
| **Termination of smoking** | Smoking is one of the prominent risk factors for COPD, CVD, and cancer. It is recommended to do the best practice to completely cease the smoking. |

| | |
|---|---|
| **Physical activity in a regular basis** | Physical exercise and activities on a regular basis have been found to be beneficial to help prevent and treat hypertension. There is evidence through studies that suggest doing jogging, walking, yoga, cycling, or swimming (56–58 Moderate-intensity aerobic exercise) for half an hour for 5–7 days in a week or taking high-intensity interval training (HIIT). Blood pressure can also be reduced by strength training for 2–3 days in a week. |
| **Reduction of stress and anxiety** | Increased BP among elderlies is more likely to be closely related to chronic stress. Clinical trials assessing the impacts of mindfulness meditation on blood pressure suggest that such an approach may help keep blood pressure in check. Reducing stress and anxieties mindfulness or meditation is recommended to be practiced as a daily habit. |
| **Complementary, alternative or traditional medicines** | A big number of people suffering from hypertension adapts to complementary, alternative or traditional medicines, especially across Africa and China. A broader but suitable diagnosis is to be ensured as to figure the efficiency as well as privacy and safety of consuming such medicines widely making the use of this treatment vulnerable. |
| **Less exposure to harsh environments like cold temperature and air pollution** | There is an experimental proof that air pollution affects adversely on blood pressure. |

*7.2 Natural Hypertension Management through Breathing Techniques*

Slow, deep breathing techniques represent an alternative to addressing high blood pressure. This process of deep breathing activates the parasympathetic nervous system which lessens the heart rate and dilates blood vessels, leading to a reduction of overall bp. The act of slow breathing makes the brain to be associated with a mode of tranquility. This in turn results the body to slow down their functions like dilation of blood vessels, digestion and heart rate. Deep breathing in a situation of stress or anxiety can allow oneself to react in a calm way and improve overall heart health (Saunders et al., 2022).

Common breathing techniques are proven to be effective at lessening high bp among hypertensive patients include: 30 second breathing exercise, equal breathing, diaphragmatic breathing and the 4-7-8 breathing technique.

i. The process of the 30 second breathing exercise includes sitting in a still quiet place and closing one's eyes to relax.

ii. Then a timer is set for 30 seconds and deep breaths are taken for 6 times.

iii. Equal breath lengths are focused in equal breathing. While sitting down in a calm space, one should inhale four times using nose with a short pause after each inhalation. Then exhale through the nose as well counting to four again followed by a brief pause. Diaphragmatic breathing focuses on the strengthening of the diaphragm which is a key to allow for more efficient breathing to cherish the muscle and brain by bringing more oxygen into the body (Saunders et al., 2022).

iv. Lastly, the 4-7-8 breathing technique is used to trigger the parasympathetic nervous system and to activate relaxation. In this breathing technique, inhalation through the nose four times and holding breath for a count of seven is done sequentially. Then exhalation is done through the mouth, making a whoosh sound, for a count of eight (Saunders et al., 2022). These breathing techniques provide effective treatment for stress management that can help lower blood pressure. Besides taking medicines prescribed by one's doctor, regular exercising, maintaining a healthy diet, limiting salt intake, avoiding smoking, doing breathing exercise regularly provide an effective method to reducing blood pressure.

### *7.3 Pharmacological Treatment*

Studies conducted from the statistical evidence from 100 countries have found that almost 50% of adults suffering from hypertension are prescribed medicines that help lower the level of BP (Geldsetzer et al., 2019; NCD Risk Factor Collaboration, 2019). On the other hand, few countries have been found to be performing good as compared to others and some countries are found worse. A variation of 20/10 mm Hg in BP is held to make a visible 50% difference in cardiovascular risk (Lewington et al., 2002). However, strategies for the diagnosis and providing treatment of hypertension have been illustrated in Figure 2. These guidelines are compatible with European and United States guidelines (Williams et al., 2018; guideline NG136, 2019).

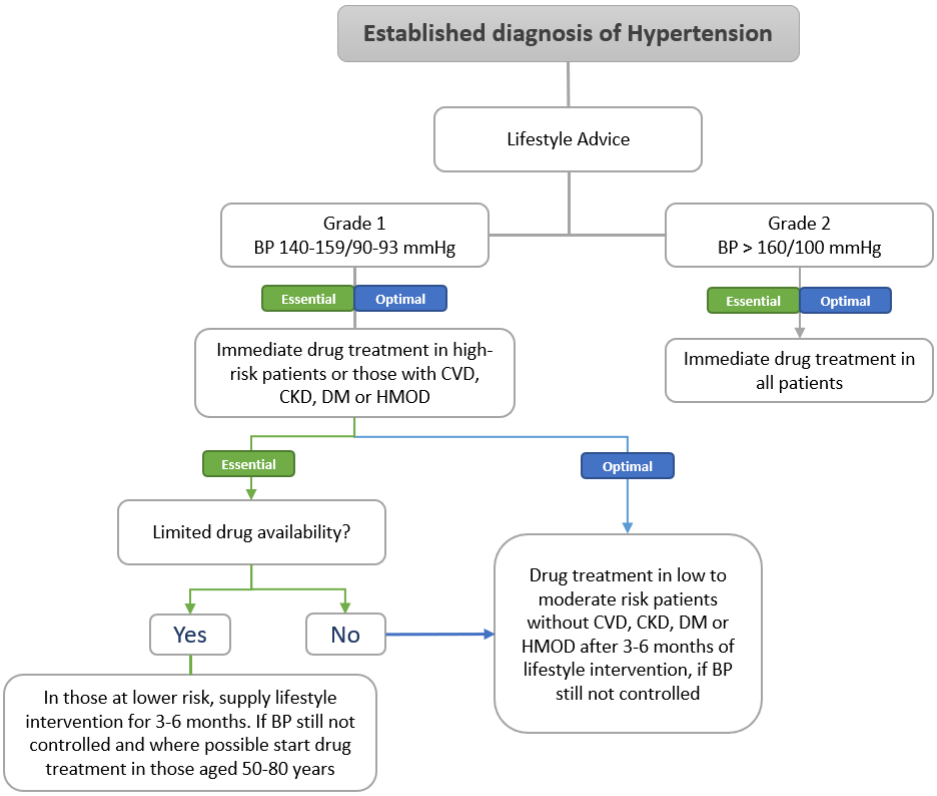


Fig. 2. General scheme of established diagnostic methods of hypertension

Table 7. Drug Treatment protocols

| | |
|---|---|
| **1** | **Treatments are needed to be evidence-based in order to prevent the morbidity/mortality rate.** |
| **2** | Regimen of daily routine is followed to control bp for 24 hours. |
| **3** | Cost-effective and affordable treatment should be provided. |
| **4** | Treatments should not create harmful side-effects and must be well-tolerated. |
| **5** | Sufficient evidence of benefits should be present for the consumption of medication in the population to whom it is to be provided. |

*7.4 Adherence to Antihypertensive Treatment*

The change in behaviors of a subject in accordance with the agreed recommendations from a physician is known as adherence (World Health Organization,2009). It may expand as to the extent of taking medicine or therapy, maintaining a diet, or following lifestyle guidelines. However, 10%–80% of hypertensive patients are affected by nonadherence making it the major driver of suboptimal control of BP (Tomaszewski et al., 2014; Mazzaglia et al., 2009;

Corrao et al., 2011). Poor adherence also accelerates the spike in BP level. The process depends somewhat on numerous factors and includes the challenges associated with healthcare and socioeconomic conditions widely (World Health Organization,2009).

## 8. Conclusion

Hypertension is one of the alarming conditions affecting over a billion people globally, but remains treatable through treatment options such as lifestyle changes and pharmacological treatment**.** The lack of awareness remains the major challenge in treatment and control rates across low-middle to higher resource countries are the key reasons for the excessive hypertension rate. Tackling issues of hypertension early in patients' lives is an effective method that may prevent severity of hypertension in the future and lead to healthier populations. In addition to pharma-logical treatment, pharmaceutical drugs which address hypertension and lower BP, lifestyle modifications remain an effective way to treat hypertension. Lifestyle modifications include primarily: salt reduction, healthy diet, weight reduction and deep breathing in addition to others (see Table 6). This process of deep breathing activates the parasympathetic nervous system resulting in calmness and a decrease in blood pressure levels. We find that to effectively address hypertension more awareness at younger ages needs to be conducted and non-pharmacological treatments should be utilized.

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