

# Reducing Cardiovascular Mortality Through Prevention and Management of Raised Blood Pressure

## A World Heart Federation Roadmap

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### 1. BACKGROUND

#### 1.1. Importance of managing and preventing raised blood pressure

Prospective epidemiological data have shown that blood pressure has a graded, continuous adverse effect on the risk of various forms of CVD (including stroke, myocardial infarction, heart failure, peripheral arterial disease and end-stage renal disease).

'Raised blood pressure' is frequently considered to be any systolic blood pressure greater than 115 mmHg. It accounts for 45% of all heart disease deaths and 51% of all stroke-related deaths [1], which together are the biggest causes of morbidity and mortality worldwide [2,3,4]. Annually, there are >17 million deaths due to CVD worldwide, of which 9.4 million are attributable to complications of raised blood pressure [1].

This highlights the importance of both high-risk and population-based strategies in blood pressure management and control.

The level of raised blood pressure for which treatments have been shown to reduce clinical events in randomized trials is generally accepted as  $\geq 140$  systolic mmHg or  $\geq 90$  diastolic mmHg and this level is therefore termed 'hypertension'. Hence, this condition relates to a relatively arbitrary blood pressure range, but for pragmatic and communication purposes, the term hypertension is used in this document. Classifications of the various commonly used levels of blood pressure are shown in Table 1.

The age-standardized levels of systolic blood pressure are dropping in some parts of the world [5]. However, despite international efforts, the size of the worldwide burden of complications of raised blood pressure in populations continues to rise; it is thought to have increased from 600 million in 1980 to 1 billion in 2008 [6], due to the expanding and ageing global population.

High-quality data are often not available on the prevalence of hypertension in low- and middle-income countries (LMICs), but similar high levels are found in HICs and LMICs. Nearly 80% of all cardiovascular mortality is estimated to occur in LMICs and this is

TABLE 1. Definitions of classes of raised blood pressure

Category	SBP (mmHg)		DBP (mmHg)
<b>Optimal</b>	<120	and	<80
<b>Normal</b>	120–129	and	80–84
<b>High normal</b>	130–139	or	85–89
<b>Grade 1 hypertension (mild)</b>	140–159	or	90–99
<b>Grade 2 hypertension (moderate)</b>	160–179	or	100–109
<b>Grade 3 hypertension (severe)</b>	$\geq 180$	or	$\geq 110$
<b>Isolated systolic hypertension</b>	$\geq 140$	and	<90

DBP, diastolic blood pressure; SBP, systolic blood pressure.

probably where the greatest burden of hypertension lies [7].

The WHO estimates that the prevalence of hypertension is highest in the African region – 46% of adults aged  $\geq 25$  years [1]. This compares with 35% in the Americas and other high-income countries and 40% in the rest of the world [1]. The PURE study also found a divergence in the prevalence of hypertension between high- and low-income countries, ranging from 26.4% in urban regions of high-income countries to 46.9% in rural upper-middle income countries [8].

Uncontrolled hypertension imposes an enormous economic burden on society. In addition to the direct costs associated with healthcare utilization (e.g., for the management of acute hemorrhagic stroke or myocardial infarction), hypertension is associated with substantial productivity losses resulting from disability and premature mortality. Productivity losses are particularly pronounced in LMICs, where weaker health systems lead to higher rates of uncontrolled hypertension and stroke and a greater likelihood of complications in younger individuals [9]. Hypertension is one of the most frequent reasons for consultation in primary care. Left untreated, it can lead to a range of devastating cardiovascular complications [1].

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The World Heart Federation Raised Blood Pressure Roadmap focuses on hypertension. This is because randomized controlled trials have shown a reduction in CVD events when treating individuals with this level of blood pressure. We estimate that the greatest impact on the prevention of CVD events can be made among those in the hypertensive range in the short time that is available to achieve the NCD targets (up to 2025). However, this high-risk-orientated approach does not deny the critical importance of primordial prevention.

Given the apt description of hypertension as a ‘silent killer’ and the lack of awareness about raised blood pressure in LMICs, opportunistic screening and awareness are the key first steps to improving management and prevention. As a consequence, the known burden of people with hypertension will – paradoxically – show an initial rise due to improved screening processes. Hence, a reasonable target for this roadmap is a 25% increase in controlled blood pressure among individuals who have been diagnosed with hypertension.

For those diagnosed with hypertension, lowering blood pressure with drugs reduces the risk of subsequent cardiovascular events [10], including a 35–40% reduction in the risk of stroke and a 20–25% reduction in the risk of myocardial infarction and heart failure [11–13].

For individuals with hypertension or high normal blood pressure (Table 1), or those at an increased risk of raised blood pressure, lifestyle modification is recommended to reduce modifiable risk factors, along with advice for rescreening.

Modifiable risk factors associated with the development and maintenance of raised blood pressure include:

- Unhealthy diet, with high salt content or insufficient fruit and vegetables;
- Harmful use of alcohol;
- Physical inactivity; and
- Overweight and obesity.

Once raised blood pressure is established, control is often attenuated due to inadequate treatment, medication non-adherence and unhealthy diets and lifestyles.

### 1.2. The care gap

A ‘care gap’ refers to the discrepancy between best practice (based on high-quality evidence) and the care provided in usual clinical practice. It can include situations in which interventions with proven efficacy are under-utilized.

Care gaps are seen in practically all countries, including high-income countries. However, they are most marked in LMICs, particularly in rural and under-resourced settings.

#### 1.2.1. Low awareness and control

The PURE study showed low levels of awareness, treatment and control of hypertension in all regions of the world (Table 2) [8].

Awareness in LMICs may be low in part because of the belief that hypertension is a disease of ‘rich countries’. Hence, screening programs may not exist. In addition, health systems in many LMICs are not equipped for the prevention and management of hypertension.

In high-income countries, the proportion of patients with undiagnosed raised blood pressure has declined in recent years. However, there remains a considerable unmet need. For example, in the US, the National Health and Nutrition Examination Survey found a growing gap between insured and uninsured adults, with the proportion of adults with hypertension who were uninsured rising from 12.3% in 1988–1994 to 17.4% in 2005–2010 [14].

A series of nationally representative cross-sectional studies in England showed that overall awareness, treatment and control of hypertension improved dramatically between 1994 and 2011 [15]. In 2011, 71% of people with hypertension were aware of it and 63% of treated patients achieved blood pressure control. Hence, despite the large unmet need, it is possible to substantially improve hypertension control at a national level in only a few years.

TABLE 2. Awareness, treatment and control of hypertension

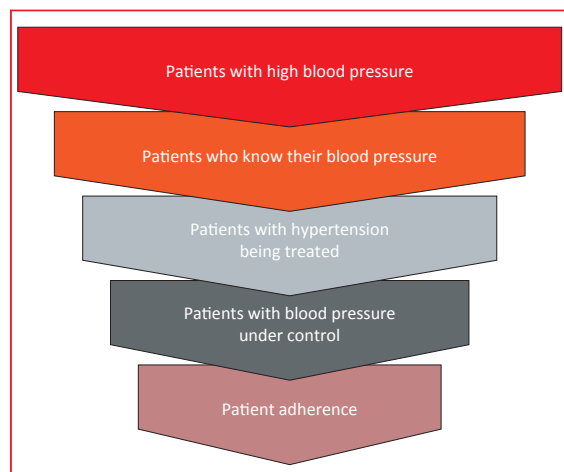
Income level	N	Aware (%)	Treated (%)	Controlled (%)
High	6263	49.0	46.7	19.0
Upper middle	18,123	52.5	48.3	15.6
Lower middle	23,269	43.6	36.9	9.9
Low	10,185	40.8	31.7	12.7
Total	57,840	46.5	40.6	13.2

Hypertension defined as systolic blood pressure  $\geq 140/90$  mmHg. Data from the PURE study [8].

### 1.3. Treatment cascade and the need to understand ‘the effect of health systems’

There are numerous reports and guidelines that outline optimal individual-level strategies for the management of hypertension. Most focus on the clinical evidence, which, although necessary, is not sufficient to implement optimal care. Health care professionals and patients exist within local, regional and national health systems that can contribute to differences in outcomes across populations. As shown in Figure 1, even when an intervention has proven efficacy in clinical trials, its real-life effectiveness will also rely on other health-system factors.

Reducing the gap between the theoretical efficacy of priority interventions and their real-world effectiveness requires a careful analysis of potentially modifiable health system barriers. This must then be followed by the development and implementation of practical, context-specific strategies (facilitators) to overcome them [16].



**FIGURE 1.** Treatment cascade for patients with hypertension.

#### 1.4. Goals of the roadmap

The objective is to present a practical roadmap that summarizes potential roadblocks (at different health-system levels) along the care pathway for patients with, or at-risk of developing, hypertension. The Roadmap presents potential solutions to overcoming these roadblocks and includes case studies from low-, middle- and high-income countries.

The evidence supporting population-based strategies for lowering blood pressure are relatively sparse but may be cost effective. (e.g., Refs [17,18]) However, they are not the focus of this Roadmap and will be discussed in subsequent documents.

This report concentrates on hypertension as a single risk factor, as an entry point to the prevention of CVD, rather than using the absolute risk approach. Hypertension does not normally occur alone and is often accompanied by other adverse risk factors which feed into the absolute risk status.

Although there is a strong epidemiological rationale for using the absolute risk approach, there is still uncertainty regarding how best to implement it in practice and there are no randomized controlled data to support its use. In addition, this approach may be too complicated (particularly in LMICs). Meanwhile, the overall risk approach is included in recommendations when considering the blood pressure threshold to initiate medical treatment and future documents will address this approach, as well as the use of risk scores for cardiovascular prevention.

## 2. PRIORITY STRATEGIES TO DECREASE THE PREVALENCE OF RAISED BLOOD PRESSURE

### 2.1. Population

The Roadmap considers four populations:

1. People who are unaware of their blood pressure status: these individuals need to have their blood pressure measured through opportunistic screening (section 2.2.1).
2. People who are aware that they have raised blood pressure, but their blood pressure remains uncontrolled: these individuals need access to quality treatment (section 2.2.2).
3. People who are aware that they had raised blood pressure, and their blood pressure is now under control: these individuals require follow up to ensure continued control (section 2.2.2.3).
4. People who are aware that they do not have raised blood pressure: these individuals should continue to have periodic screening and lifestyle advice.

### 2.2. Key steps for improving hypertension management

To lower the prevalence of uncontrolled hypertension, there are a number of key steps:

- Opportunistic screening so that people are aware of their blood pressure status (section 2.2.1).
- Effective drug treatment for:
  - All individuals with systolic blood pressure  $\geq 160$  mmHg or diastolic blood pressure  $\geq 100$  mmHg.
  - All individuals with systolic blood pressure  $\geq 140$  mmHg or diastolic blood pressure  $\geq 90$  mmHg, if they are considered to be at overall high-risk (section 2.2.2).
- Education for all hypertensive individuals on the importance of lifelong adherence to lifestyle modification and medication use (section 2.2.3).

#### 2.2.1. Screening

A key challenge in reducing the overall burden of hypertension is to address the fact that most hypertensive individuals are asymptomatic for a variable but prolonged period prior to a significant cardiovascular event. Thus, screening strategies are crucial.

Screening for hypertension is relatively simple and there are standard management algorithms that can be deployed for best use of resources [19]. Opportunistic screening can be conducted when individuals have contact with Health Care Professionals (HCPs) in workplaces, as part of antenatal care, in pharmacies, and in mobile units set up specifically for screening. People can be engaged through mass media campaigns, media, mail, or through points of contact. Local facilities will determine optimal practice.

As a minimum, doctors should screen patients attending clinics for any reason at least once a year, although this should be done only when there is possibility of treatment. Caution must be exercised not to over interpret blood pressure that is raised for other reasons (e.g., pain).

The ideal method of screening involves 24-hour ambulatory or home-based methods [20,21]. However, these are often not feasible for practical reasons and the minimum best practice is probably to take serial paired blood pressure readings over a period of time. If a patient is on the borderline, they should have more screening done before a treatment decision is made.

Failure to carry out multiple screenings to confirm the diagnosis may lead to false positives [22]. However, in low-resource settings, this may not be possible. In such instances, two readings in sequence are recommended at each screening. If the first is normal (<140/90 mmHg), it is not necessary to conduct a second reading. If there is a >10 mmHg difference between the two readings, a third should be made and the mean of the last two used.

If the average is >160 mmHg, the patient should be treated with drugs and dietary and lifestyle advice immediately. If the average is 140–159 mmHg, the patient should be given dietary and lifestyle advice and instructed to return in 1–2 months; if the mean blood pressure remains at 140–159 mmHg and they are at high risk (according to local definitions), drug treatment should be added. If mean blood pressure is <140 mmHg, dietary and lifestyle advice should be maintained.

## 2.2.2. Treatment

**2.2.2.1. Treatment thresholds.** Most guidelines define hypertension as systolic blood pressure  $\geq 140$  mmHg and/or diastolic blood pressure  $\geq 90$  mmHg, or the patient being prescribed antihypertensive agents (Appendix A). However, the guidelines differ regarding treatment thresholds (Appendix A).

For pragmatic reasons, the WHF Roadmap recommends the following after serial readings (Table 3):

**2.2.2.2. Medications.** Recommended treatments also differ across guidelines (Appendix A). Ideally, medications should have been shown in clinical trials to reduce blood pressure and cardiovascular morbidity and mortality in the type of population and patient for which they are being prescribed. However, such data are often unavailable.

In the absence of such data, it is not surprising that guidelines vary in their recommendations. These inconsistencies highlight the need for more trial data to inform optimal drug selection and sequencing. Meanwhile, we recommend that, in addition to the consideration of

local guidelines, drug availability, and affordability, physicians consider the following general principles:

1. It is critical that blood pressure levels of hypertensive patients are effectively lowered, and the means whereby that is achieved are probably of secondary importance.
2. Coexisting conditions are likely to influence the ideal therapy for individual patients.
3. Because the majority of patients with hypertension require two or more drugs to achieve blood pressure control, several hypertension guidelines make the pragmatic recommendation (albeit not as yet confirmed by supportive RCT data) to initiate therapy with two drugs (initially at low doses). Based on observational data, this approach is associated with more rapid and effective blood pressure lowering with fewer side-effects, with being more cost-effective, and being more likely to prevent associated cardiovascular events. The benefits of such an approach are likely enhanced by the use of single pill combinations of drugs where they are cheap and available.
4. In addition to blood pressure lowering, also try to improve other risk factors (particularly smoking and cholesterol levels) because these added measures are also likely to reduce morbidity and mortality.

An economic model assessing first-line drug treatment of hypertension with generic angiotensin-converting enzyme (ACE) inhibitors or angiotensin receptor blockers (ARBs), beta-blockers, dihydropyridine calcium channel blockers (CCBs), and thiazide-type diuretics compared with no intervention found that treatment was highly cost-effective [23]. Health outcomes (based on quality-adjusted life years) were improved, and there were cost savings with all drug classes relative to no treatment.

In general, the use of generic rather than proprietary medications can substantially reduce the cost of care, both by reducing medication costs and by reducing long-term complications due to improved adherence. However, the quality of generic agents is critical to their recommended use.

The unaffordability of essential cardiovascular medicines in LMICs is well documented [24]. The PURE study found that the lowest uptake of antihypertensive drugs was in low-income countries and hypothesized that even though low-cost generics were available, cost (as proportion of income) was still a limiting factor [8]. In Ghana, 93% of people with hypertension reported being

TABLE 3. Threshold algorithm

Blood pressure	Risk category	Action required
SBP $\geq 160$ mmHg <i>or</i> DBP $\geq 100$ mmHg	—	Initiate drug treatment
SBP 140–159 mmHg <i>or</i> DBP 90–99 mmHg	High risk (as per local guidelines)	Initiate drug treatment
SBP 140–159 mmHg <i>or</i> DBP 90–99 mmHg	Low risk	Emphasize diet and lifestyle changes with regular (e.g., 6-monthly) re-screening

DBP, diastolic blood pressure; SBP, systolic blood pressure.

non-adherent with their medicines; of these, 96% claimed that the main reason was unaffordability [25].

There are documented examples of context-specific issues that affect the affordability of essential cardiovascular medicine in LMICs. For example, in Malaysia, the mark-up of generic drug prices, such as generic atenolol, varied greatly depending on the setting: 46.5% in the public sector; 149.5% in private-sector retail pharmacies; 234.0% from dispensing doctors [26].

**2.2.2.3. Follow-up.** After initiating therapy, follow up should ideally occur within 6–8 weeks. If blood pressure is still uncontrolled, the medication should be up-titrated and the patient followed up every 3 months with further up-titration until control is achieved. Once blood pressure is under control, follow up should occur every 6–12 months.

This schedule should consider patient costs (including transport and loss of wages due to taking time off for visits), which affect compliance and the burden to the healthcare system.

### 2.2.3. Education and adherence

The asymptomatic nature of hypertension is a barrier to long-term medication adherence. Both patients and HCPs must be educated on non-pharmacological methods of blood pressure control, including heart-healthy diet (reduced salt and fat intake and increased fruit and vegetables), weight control, alcohol use modification, and physical activity, according to local guidelines.

It is also necessary to understand that blood pressure medications are nearly always required for life, and should be continued even after normal blood pressure is achieved. Patients must learn the importance of adherence both through education and through education interventions.

Education should be given to care givers, patients and families and can be provided through pamphlets, group therapy, and the education of community health workers and General Practitioners (e.g., Ref [27]). Local circumstances will inform the optimal methodology.

## 3. MAPPING THE HEALTH-SYSTEM REQUIREMENTS TO ACHIEVE RAISED BLOOD PRESSURE TARGETS

### 3.1. Mapping health-system requirements

The WHO Global Action Plan (GAP) for the Prevention and Control of NCDs 2013–2020 [28] sets out six objects, nine global NCD targets, a comprehensive global monitoring framework (including a set of indicators) and a menu of policy options to achieve these targets by 2025.

One target directly relates to raised blood pressure at the population level: a 25% relative reduction in the prevalence of raised blood pressure or contain the prevalence of raised blood pressure, according to national circumstances [28].

Other targets associated with raised blood pressure include: a 30% relative reduction in mean population intake of salt/sodium; and a 10% relative reduction in the prevalence of insufficient physical activity [28].

There are also two applicable medicine-based targets: at least 50% of eligible people receiving drug therapy and counselling (including glycaemic control) to prevent heart attacks and strokes; and 80% availability of affordable basic technologies and essential medicines, including generics, required to treat major NCDs in both public and private facilities [28].

Many countries have already implemented the WHO package for essential NCD interventions for primary health care in low-resource settings [29]. The WHO package of essential NCD (PEN) recommendations can be found in [Appendix A](#).

Many barriers and solutions have been proposed, but more high-quality studies are required to understand barriers and solutions [24].

Meanwhile, we have identified three key areas for immediate action:

1. **Opportunistic screening**
2. **Improved treatment**
3. **Education**

[Table 4](#) describes several of the most important requirements in achieving these.

## 4. ROADMAP TO THE MANAGEMENT AND CONTROL OF RAISED BLOOD PRESSURE TARGET

### 4.1. Overcoming roadblocks

The health-system requirements or conditions in [Table 4](#) are vital to the journey of patients with hypertension. Different roadblocks could appear at different stages of this journey and prevent patients from controlling their blood pressure. Although variable by region, [Table 5](#) identifies some of the potential roadblocks and proposes solutions for overcoming them.

### 4.2. Health-system solutions

#### 4.2.1. Physical resources

Data from Ethiopia have identified a direct association between travel time to clinic (<30 minutes vs  $\geq$ 30 minutes) and medication adherence in patients with hypertension [30]. While the expected return on investing in physical resources such as primary health clinics is far greater than an effect on medication adherence, the upfront and maintenance costs are substantial and usually part of a larger health system development program.

#### 4.2.2. E-health

The ubiquity and affordability of mobile technology have created unique opportunities to transform healthcare delivery in resource-scarce settings by expanding access, lowering costs and improving quality [31]. In this context, the term ‘e-health’ refers to the use of information technology to deliver medical care or public health services. A subset of e-health is m-health, defined as the use of mobile devices to support the delivery of medical care or public health services.

TABLE 4. Health-system requirements to achieve raised blood pressure management targets

Actions needed to achieve the raised blood pressure target	Individuals aware they are at risk/aware of their blood pressure	Priority medicines* are prescribed	Patients are adherent to treatment plan
 <b>Human resources</b>	Availability of trained HCPs to do screening	Availability of HCPs to prescribe recommendations at diagnosis and for long-term education of HCPs on guidelines	HCPs aware that blood pressure treatment is nearly always for life
 <b>Physical resources</b>	Calibrated sphygmometers Settings for opportunistic screening	Availability of priority interventions at community level* Healthcare-system facilities available and accessible to patients when and where needed	
 <b>Intellectual resources</b>	Availability of standardized guidelines for screening	Availability of practical and locally relevant clinical guidelines	
 <b>Healthcare delivery</b>	Opportunistic screening	Healthcare organized to maximize existing resources to ensure efficiency in the interaction between HCPs and patients Adequate supply of affordable medications	
 <b>Healthcare recipient</b>	Patients aware that they are at risk/open to screening	Interventions culturally acceptable	Patients aware and willing to follow recommendations Patients understand that recommendations are for life
 <b>Financing</b>	Free availability of screening	Patients can afford access to healthcare facilities Priority interventions are affordable to both the healthcare system and the patient	
 <b>Governance</b>	Adequate governance to support screening	Adequate political and regulatory framework supporting the strategy to implement and maintain priority interventions	
 <b>Information System</b>	Ability to link identified individuals with treatment	A simple, timely, acceptable and representative information system to provide reliable data about the incidence, prognosis and quality of care of patients with hypertension or at high-risk of hypertension	

HCP, healthcare professional.

\*ACE inhibitor or angiotensin receptor blocker; beta-blocker; calcium channel blocker; diuretic.

There are many ongoing trials examining the role of mobile technology in hypertension management in low-resource settings, particularly by empowering community health workers with a decision support system to manage patients and track outcomes. This process — called task-sharing because it enables other providers to perform tasks previously restricted to physicians — improves access to high-quality hypertension management in settings where trained providers are scarce. The decision support system helps the community health worker to counsel patients, intervene on modifiable risk factors and provide long-term management of hypertension. Task-sharing can reduce costs and expand access to care. Patient-facing mobile health interventions can use strategic text messages to improve medication adherence and to ensure follow-up.

A new joint venture from the United Nations, International Telecommunication Union (ITU) and WHO called 'Be He@lthy, Be Mobile', uses apps and text messages to promote cardiovascular health. There are eight participating countries, starting with Costa Rica. The first initiative dealt primarily with smoking cessation and the second is dealing specifically with hypertension [32].

Well-designed studies examining the long-term clinical and economic impact of mobile health applications in the management of raised blood pressure should be a research priority. In the meantime, in the absence of high-quality evidence regarding their long-term effectiveness, results should be treated cautiously.

#### **4.2.3. Decision support systems (DSS)**

These are tools that help clinicians to decide on appropriate actions based on patient status. There is growing evidence to support the effectiveness of DSS for the management of hypertension.

A systematic review and meta-analysis of five studies found a decrease in systolic blood pressure when using either computerized or non-computerized DSS compared with control groups [33].

A recent study conducted in India found that use of clinical DSS significantly reduced both systolic and diastolic blood pressure after 12 months compared with a chart-based system; the number of patients with their blood pressure under control was significantly higher in the DSS group and the cost-effectiveness ratio was roughly one third per unit reduction compared with the chart-based system [34].

#### **4.2.4. Training of community health workers**

The Simplified Cardiovascular Management in India and China Study (Simcard) has evaluated the effectiveness of training community health workers to follow up and manage high CVD risk patients [35]. Treatment involved two lifestyle recommendations and the appropriate prescription of one antihypertensive medication and one CVD risk-lowering medication (aspirin). Preliminary results showed a significant increase in high-risk individuals taking anti-hypertensive drugs and a reduction in systolic blood pressure.

#### **4.2.5. Innovative models for care delivery: hypertension management**

The HOPE-4 study was launched in Colombia and Malaysia in August 2014 to detect, treat and control hypertension, via an innovative model that is scalable to the national level [36]. The project involved non-physician health workers providing education on CVD and hypertension, advice on lifestyle modifications, therapy initiation and referral of high-risk patients to physicians.

The Control of Blood Pressure and Risk Attenuation-1 (Cobra-1) study showed that quarterly family-based home health education from lay health workers and annual training of GPs in hypertension management, led to significant reductions in blood pressure among patients with hypertension in Pakistan [27].

#### **4.2.6. Overcoming governance issues: A case study**

The Pan American Health Organization has made the prevention and control of hypertension a priority in controlling NCDs, with a plan of achieving population-level hypertension control of 35% by 2019. To achieve this, it will be necessary to increase awareness, treatment and control among treated individuals by over 70%. In conjunction with the US Centre for Disease Control and other global and regional partners, they have developed the Global Standardized Hypertension Treatment Project (GSHTP).

This project promotes care elements that can be integrated into any healthcare system. Central to its strategy is increased surveillance, salt/sodium restriction, increased physical activity and obesity control, simplified messaging, promotion of assessment of cardiovascular risk, increased access to anti-hypertensive drugs and the provision of counselling and multi-drug therapy to people with high cardiovascular risk in LMICs [37].

The GSHTP toolkit can be viewed at: <http://www.cdc.gov/globalhealth/ncd/hypertension-toolkit.htm>.

The Organization of Eastern Caribbean States (OECS) Pharmaceutical Procurement Service (PPS) project allows nine countries to purchase essential medicine through annual contracts, instead of individual countries purchasing medicines by direct negotiation, thereby ensuring that the best price is standardized throughout participating members [38]. This has reduced the costs to the individual countries, enhanced the efficiency of health service delivery and assured quality control, increasing the availability of essential hypertension drugs.

#### **4.2.7. Information systems**

Different health-information system models for blood pressure surveillance are possible in different settings. To be useful, they should have some of the key attributes of well-functioning health surveillance systems, such as simplicity, acceptability, representativeness and timeliness.

Specifically, WHO has developed the STEPwise approach, which is a tool used to collect data and measure NCD risk factors, including hypertension [39].

**TABLE 5.** Roadblocks, strategies and solutions to achieve management and control of raised blood pressure targets

Roadblock	Potential solutions			
Patients are unaware that they are at risk of hypertension/unaware of their hypertension status	Provide opportunistic screening	Education campaigns	Open health centers close to communities in rural areas	Involve health workers at the community level
Lack of understanding of risk/guidelines by HCPs	Educate HCPs			
Lack of HCPs to screen/prescribe priority interventions	Promote task-sharing/scope of practice			
Guidelines are not available or are too complex	Develop simple and practical guidelines	Support clinical decision support systems	Support e-health	
HCPs are not aware of guidelines	Educate HCPs	Audit and elicit feedback	Support clinical decision support systems	
HCPs are aware but do not follow guidelines	Identify and engage local opinion leader	Provide financial incentives	Support clinical decision support systems	
Lack of political leadership and partnerships with relevant organizations	Develop, strengthen and/or provide links to hypertension societies	Identify and engage local/national champions		
Priority interventions are not available	Include priority interventions in the national list of essential medicines	Ensure that priority interventions are available at the community level (including pharmacies)		
Priority interventions are not affordable	Promote the use of good quality generic medications	Promote local manufacturing, bulk purchasing and/or efficient system to streamline medication supply	Provide financial and social support for patients to purchase priority interventions	Choose low-cost alternatives in settings where there is idiosyncratic pricing
Lack of linkage between diagnosis and treatment	Educate HCPs	Educate health care recipients	Support e-health	
Patients are not aware of the importance and need for long-term treatment	Educate patients	Conduct public campaigns	Support e-health	
Patients do not remember to follow recommendations	Use information and communication technology to remind patients about recommendations	Support e-health	Use patient-nominated, non-professional treatment supporters (e.g., spouse, friends, family)	

Sources of evidence are provided in Appendix B.

Other simple approaches to risk factor surveillance and information systems in limited-resource settings have been recently implemented in Kerala, India. Details of this initiative are reported in the WHF Secondary Prevention Roadmap [40].

## 5. CONCLUSIONS AND RECOMMENDATIONS

There are proven cost-effective lifestyle and medical interventions to prevent and manage hypertension. However, uptake is still unacceptably low, particularly in resource-poor areas. The WHO attributes 45% of cardiovascular deaths to complications of raised blood pressure [1] and hence the

improved management of hypertension is crucial to the overall goal of reducing premature mortality by 25% by 2015.

This Roadmap examined the barriers at various health-system levels to effective prevention, management and control of hypertension and proposed potentially cost-effective solutions to overcoming these barriers.

The ideal journey proposed by this Roadmap for individuals with hypertension includes the following steps:

1. Governmental and societal willingness to make hypertension control a priority, including low-cost medications;
2. Ensure that individuals are aware of their blood pressure;



3. Known lifestyle modifications to help in the prevention and management of hypertension;
4. Treatment with cost-effective medications; and
5. Education of both HCPs and patients to address adherence to treatment and understanding that blood pressure control is a lifelong commitment.

Barriers and solutions differ according to region and should be tailored to each setting. However, some of the most important solutions put forth in this Roadmap, particularly those relevant to LMICs include:

1. Opportunistic screening;
2. Design simple and practical guidelines;
3. Educate HCPs on guidelines;
4. Implement task-sharing and expand the scope of practice;
5. Support clinical decision support systems for HCPs;
6. Develop and strengthen links to hypertension societies;
7. Promote the use of inexpensive, good-quality generic medications;
8. Support e-health and educate healthcare recipients and care givers for linkage between diagnosis and treatment;
9. Conduct education campaigns for healthcare recipients and care givers to promote understanding of adherence and the importance of long-term treatment;
10. Support information and communications technology to remind patients to take their medication.

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## APPENDIX A. BLOOD PRESSURE GUIDELINES

	WHO PEN [1]	NICE 2011 [2]	ESH/ESC 2013 [3]	ASH/ISH 2014 [4]	AHA/ACC/CDC 2013 [5]	US JNC 8 2014 [6]
<b>Definition of hypertension*</b>	≥140/90	≥140/90 and daytime ABPM (or home BP) ≥135/85	≥140/90	≥140/90	≥140/90	Not addressed
<b>Drug therapy in low-risk patients after non-pharmacologic treatment*</b>	>160/100	≥160/100 or daytime ABPM ≥150/95	≥140/90	≥140/90	≥140/90	<60 years, ≥140/90; ≥60 years, ≥150/90
<b>First-line therapy</b>	<55 years, low-dose thiazide diuretic and/or ACE inhibitor; ≥55 years, CCB and/or low-dose thiazide diuretic	<55 years, ACE inhibitor or ARB; ≥55 years or African ancestry, CCB	ACE inhibitor or ARB; beta-blocker; CCB; diuretic	Low-dose diuretic		ACE inhibitor or ARB; CCB; diuretic CCB/diuretic in people of African ancestry
<b>Beta-blockers as first-line drug</b>	No	No (step 4)	Yes (in specific subgroups)	No (step 4)	No (step 3)	No (step 4)
<b>Diuretic</b>	Thiazides,	Chlortalidone, indapamide	Thiazides, chlortalidone, indapamide	Thiazides, chlortalidone, indapamide	Thiazides	Thiazides, chlortalidone, indapamide
<b>Initiate drug therapy with two drugs*</b>	Not mentioned	Not mentioned	In patients with markedly elevated BP or patients with high overall CV risk	≥160/100	≥160/100	≥160/100
<b>Blood pressure target*</b>	<140/90	<140/90; ≥80 years, <150/90	<140/90; elderly <80 years, SBP 140–150, SBP <140 in fit patients; elderly ≥80 years, SBP 140–150	<140/90; ≥80 years, <150/90	<140/90; lower targets may be appropriate in some patients, including the elderly	<60 years, <140/90; ≥60 years, <150/90
<b>Blood pressure target in patients with diabetes mellitus*</b>	<130/80	Not addressed	<140/85	<140/90	<140/90; lower targets may be considered	<60 years, <140/90; ≥60 years, <150/90

ABPM, ambulatory blood pressure monitoring; ACC, American College of Cardiology; ACE inhibitor, angiotensin-converting enzyme inhibitor; AHA, American Heart Association; ARB, angiotensin receptor blocker; ASH, American Society of Hypertension; BP, blood pressure; CCB, calcium channel blocker; CDC, Centers for Disease Control and Prevention; CV, cardiovascular; ESC, European Society of Cardiology; ESH, European Society of Hypertension; ISH, International Society of Hypertension; NICE, National Institute for Health and Care Excellence; SBP, systolic blood pressure; US JNC 8, Eighth US Joint National Committee; WHO PEN, World Health Organization Package of Essential Noncommunicable disease interventions.

\*BP measured in mmHg.

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## APPENDIX B. SYSTEMATIC REVIEWS EVALUATING THE PROPOSED SOLUTIONS TO ACHIEVE MANAGEMENT AND CONTROL OF RAISED BLOOD PRESSURE TARGETS

Potential solutions	References
<b>Education</b>	[1,2]
Local opinion leaders	[3]
<b>Simplified guidelines</b>	[4]
Simplified treatment (fixed-dose combination)	[5]
<b>Task shifting to non-physicians</b>	[6,7]
Financial incentives	[8]
<b>eHealth</b>	[9]
Reduce treatment costs	[10,11]
<b>Financial support</b>	[12]
Reminders (eHealth)	[9]
<b>Self-management</b>	[13]
Produce (adapt) simplified national guidelines	[4]
<b>Social support (access to healthcare facilities, health insurance)</b>	[12]

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