Practical steps for Blood Pressure Management

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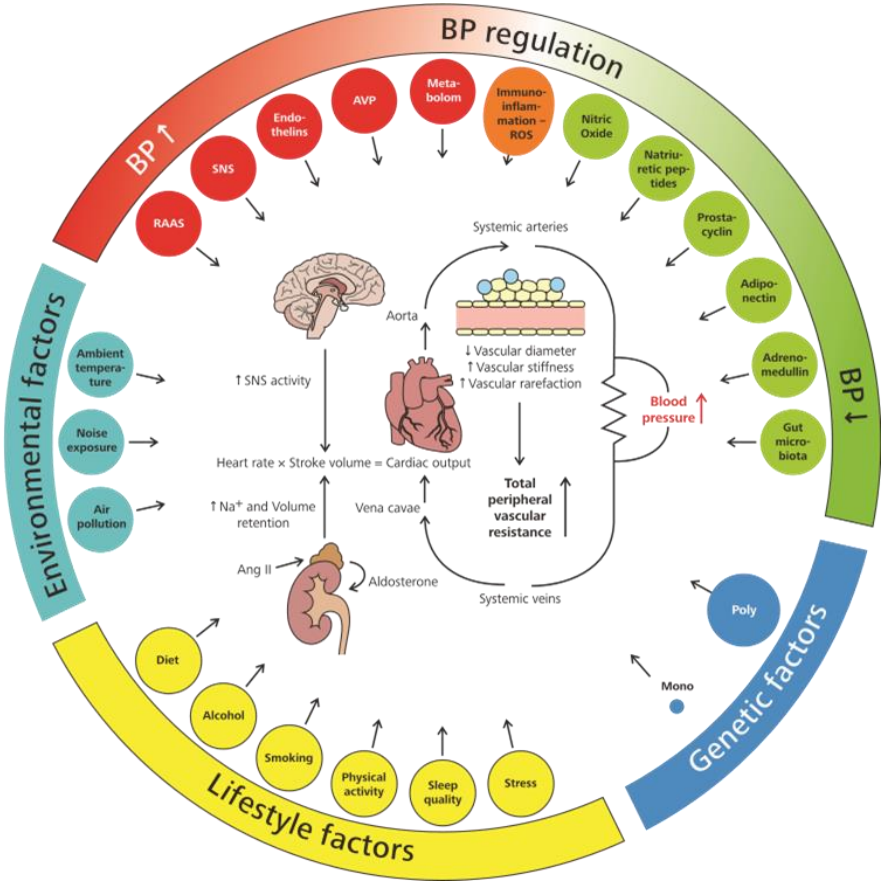
THIS IS MODERN MEDICINE


BP regulation
BP ↑
RAAS
SNS
Endo-thelins
AVP
Meta-bolom
Immuno-inflam-mation – ROS
Nitric Oxide
Natriu-retic pep-tides
Prosta-cyclin
Adipo-nectin
Adreno-medullin
Gut micro-biota
BP ↓
Blood pressure
Systemic arteries
Aorta
↓ Vascular diameter
↑ Vascular stiffness
↑ Vascular rarefaction
↑ SNS activity
Heart rate × Stroke volume = Cardiac output
Total peripheral vascular resistance
↑ Na+ and Volume retention
Vena cavae
Ang II
Aldosterone
Systemic veins
Environmental factors
Ambient tempera-ture
Noise exposure
Air pollution
Lifestyle factors
Diet
Alcohol
Smoking
Physical activity
Sleep quality
Stress
Genetic factors
Poly
Mono

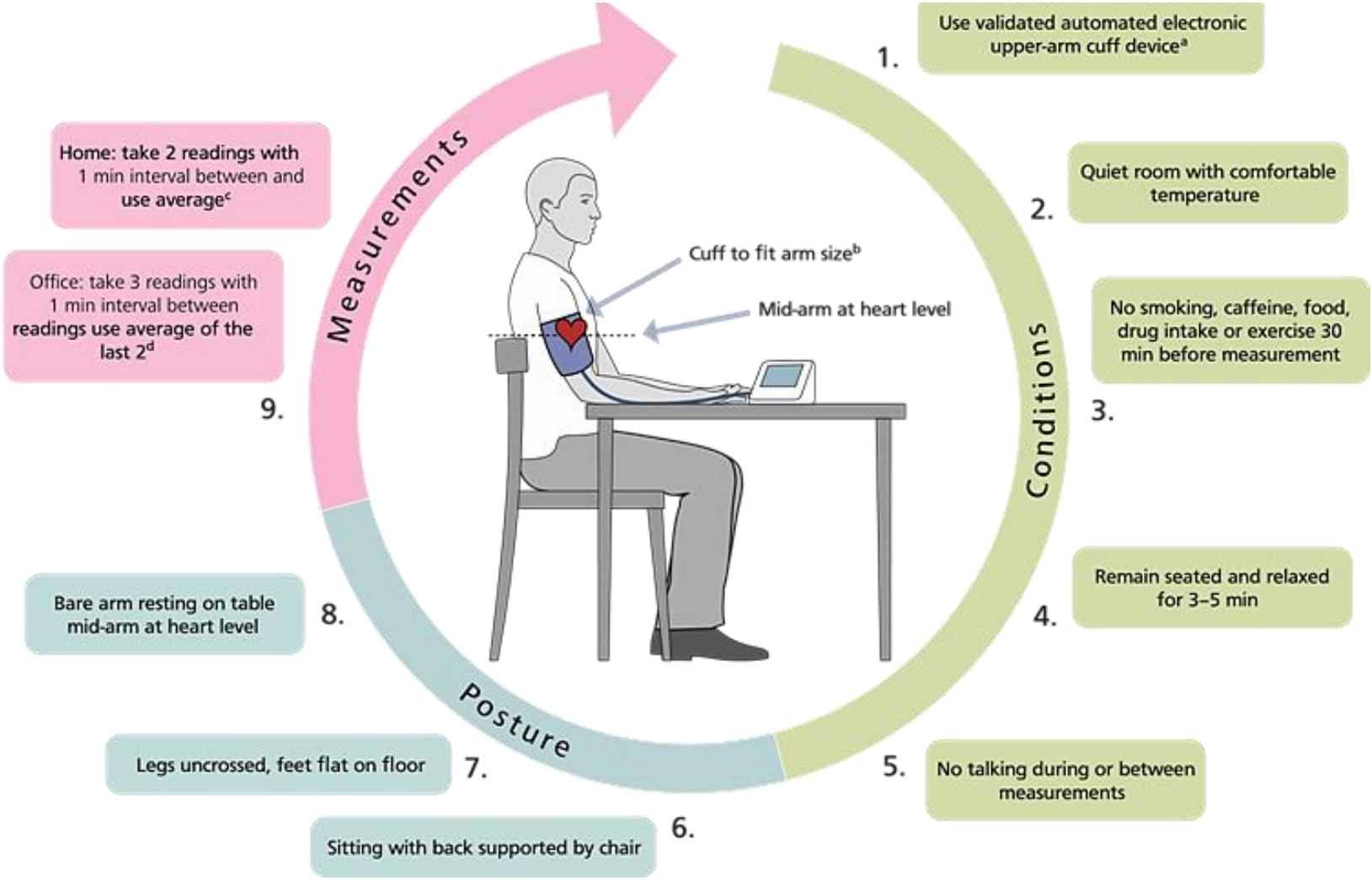
Know Your Numbers

Category	Systolic (mmHg)		Diastolic (mmHg
Optimal	<120	and	<80
Normal	120–129	and	80–84
High-normal	130–139	and/or	85–89
Grade 1 hypertension	140–159	and/or	90–99
Grade 2 hypertension	160–179	and/or	100–109
Grade 3 hypertension	180	and/or	110
Isolated systolic hypertension[a]	140	and	<90
Isolated diastolic hypertension[a]	<140	and	90

Hypertension disease staging	Other risk factors, HMOD, CVD or CKD	BP (mmHg) grading			
		High-normal SBP 130–139 DBP 85–89	Grade 1 SBP 140–159 DBP 90–99	Grade 2 SBP 160–179 DBP 100–109	Grade 3 SBP ≥ 180 DBP ≥ 110
Stage 1	No other risk factors[a]	Low risk	Low risk	Moderate risk	High risk
	1 or 2 risk factors	Low risk	Moderate risk	Moderate to high risk	High risk
	≥3 risk factors	Low to moderate risk	Moderate to high risk	High risk	High risk
Stage 2	HMOD, CKD grade 3, or diabetes mellitus	Moderate to high risk	High risk	High risk	Very high risk
Stage 3	Established CVD or CKD grade ≥4	Very high risk	Very high risk	Very high risk	Very high risk

	<50 years	60–69 years	≥70 years
	<2.5%	<5%	<7.5%
	2.5 to <7.5%	5 to <10%	7.5 to <15%
	≥7.5%	≥10%	≥15%

Complementary risk estimation in Stage 1 with SCORE2/SCOR2-OP


Measurements
Conditions
Posture
1. Use validated automated electronic upper-arm cuff device[a]
2. Quiet room with comfortable temperature
3. No smoking, caffeine, food, drug intake or exercise 30 min before measurement
4. Remain seated and relaxed for 3–5 min
5. No talking during or between measurements
6. Sitting with back supported by chair
7. Legs uncrossed, feet flat on floor
8. Bare arm resting on table mid-arm at heart level
9. Office: take 3 readings with 1 min interval between readings use average of the last 2[d]
Home: take 2 readings with 1 min interval between and use average[c]
Cuff to fit arm size[b]
Mid-arm at heart level

Clinical Assessment

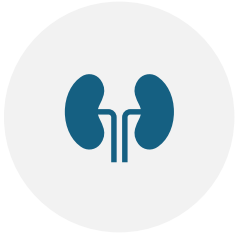
HISTORY, INCLUDING LIFESTYLE

PHYSICAL EXAMINATION, FUNDOSCOPY

BMI / WAIST

ABPM, HBPM, OBPM TO CONFIRM DIAGNOSIS

ECG, ECHO, CT, RENAL US, VASCULAR

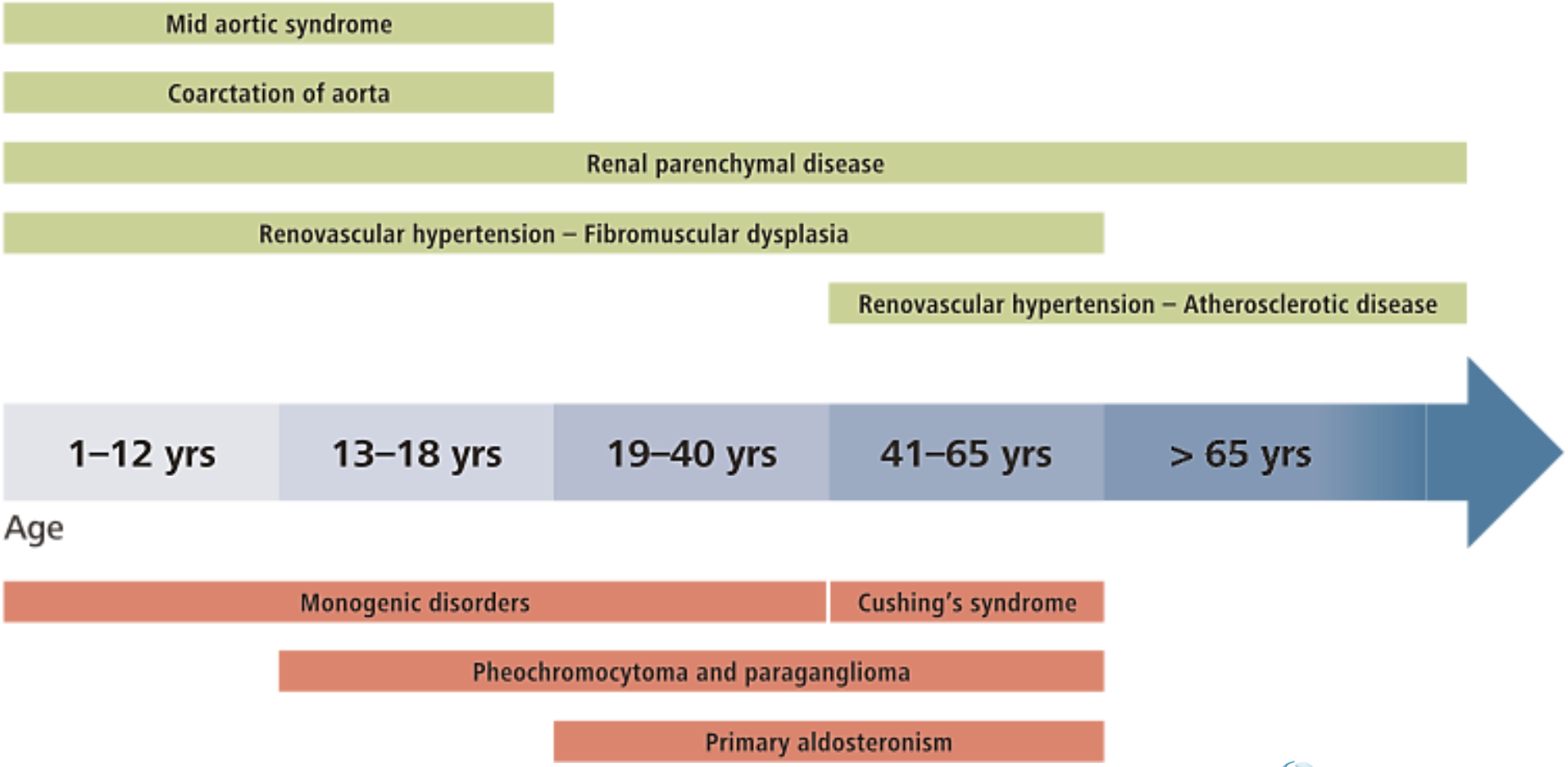


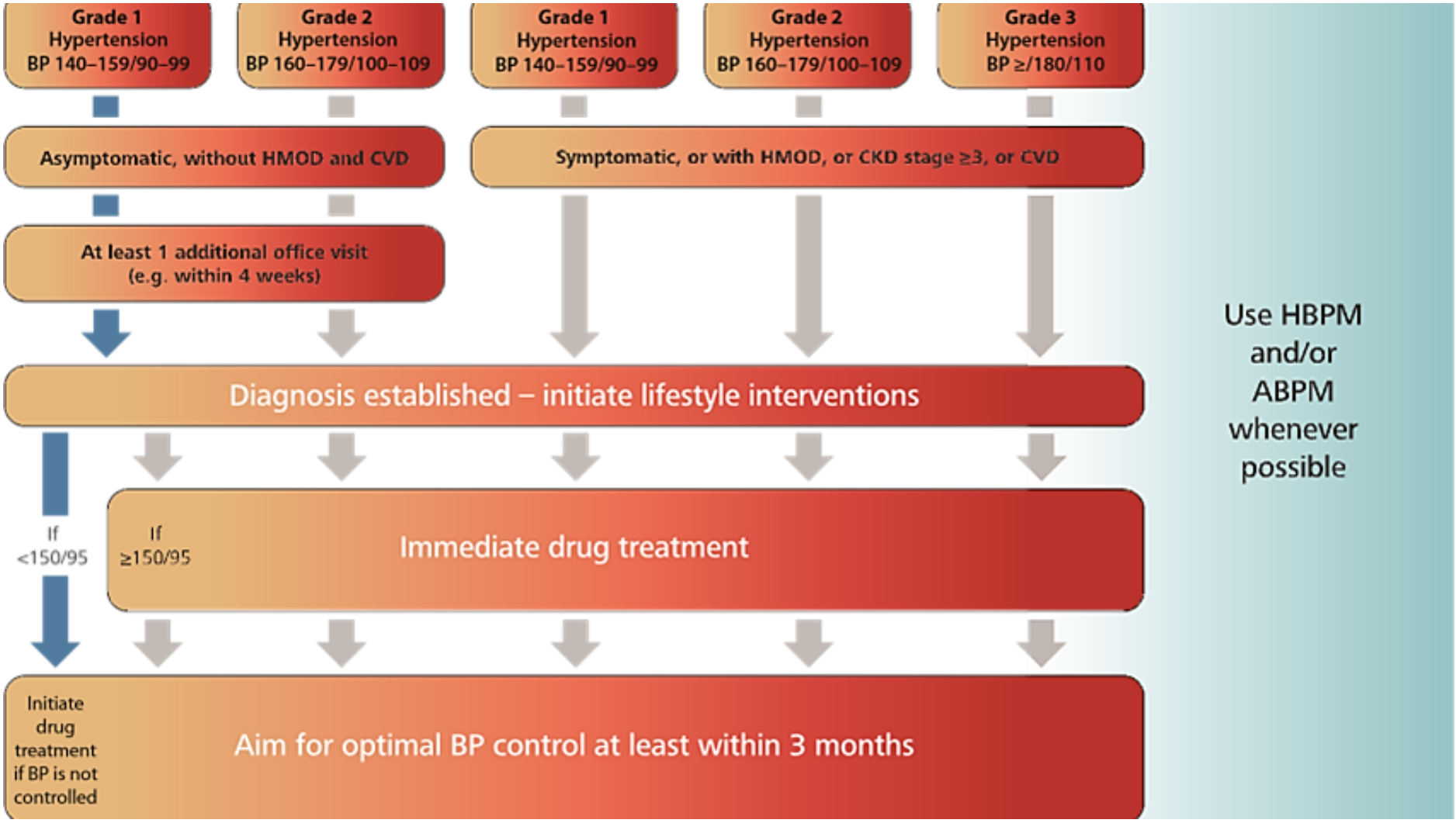
LABS – FBC, UE, TFTS, UA, VMA, URINALYSIS, HBA1C, FBG,

TABLE 2. Factors that influence CV risk in patients with hypertension

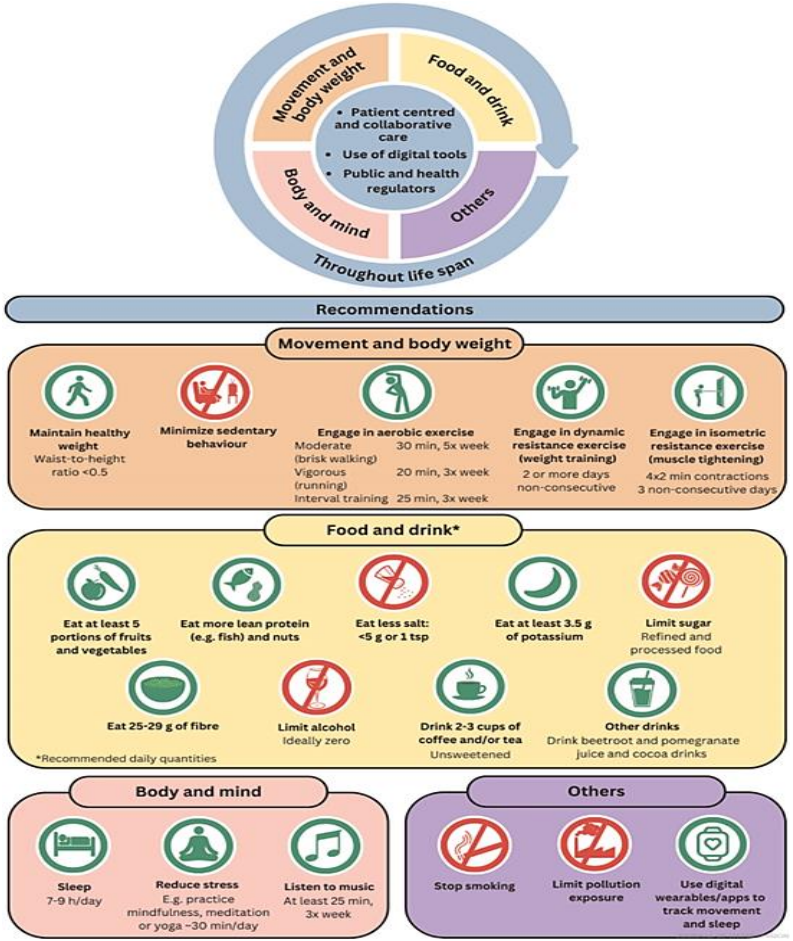
- Parameter for risk stratification, which are included in SCORE2 and SCORE2-OP
  - Sex (men >women)
  - Age
  - Level of SBP[a]
  - Smoking – current or past history
  - Non-HDL cholesterol
- Established and suggested novel factors
  - Family or parental history of early onset hypertension
  - Personal history of malignant hypertension
  - Family history of premature CVD (men aged <55 years; women aged <65 years)
  - Heart rate (resting values >80 bpm)
  - Low birth weight
  - Sedentary lifestyle
  - Overweight or Obesity
  - Diabetes
  - Uric acid
  - Lp(a)
  - Adverse outcomes of pregnancy (recurrent pregnancy loss, preterm delivery, hypertensive disorders, gestational diabetes)
  - Early-onset menopause
  - Frailty
  - Psychosocial and socioeconomic factors
  - Migration
  - Environmental exposure to air pollution or noise
- Additional clinical conditions or comorbidities
  - True resistant hypertension
  - Sleep disorders (including OSA)
  - COPD
  - Gout
  - Chronic inflammatory diseases
  - Nonalcoholic fatty liver disease (NASH)
  - Chronic infections (including long COVID-19)
  - Migraine
  - Depressive syndromes
  - Erectile dysfunction
- Hypertension-mediated organ damage (HMOD)
  - Increased large artery stiffness:
  - Pulse pressure (in older people) 60 mmHg
  - Carotid–femoral PWV >10 m/s (if available)
  - Presence of non-hemodynamically significant atheromatous plaque (stenosis) on imaging
  - ECG LVH (Sokolow–Lyon index >35 mm, or R in aVL 11 mm; Cornell voltage-duration product (Þ6 mm in women) >2440 mm ms, or Cornell voltage >28 mm in men or >20 mm in women)
  - Echocardiographic LVH (LV mass index: men >50 g/m$^{2.7}$; women >47 g/m$^{2.7}$ (m ¼ height in meters); indexation for BSA may be used in normal-weight patients: >115 g/m^2 in men and >95/m^2 in women
  - Moderate increase of albuminuria 30–300 mg/24 h or elevated ACR (preferably in morning spot urine) 30–300 mg/g
  - CKD stage 3 with eGFR 30–59 ml/min/1.73 m^2
  - Ankle–brachial index <0.9
  - Advanced retinopathy: hemorrhages or exudates, papilledema
- Established cardiovascular and kidney disease
  - Cerebrovascular disease: ischemic stroke, cerebral hemorrhage, TIA
  - Coronary artery disease: myocardial infarction, angina, myocardial revascularization
  - Presence of hemodynamically significant atheromatous plaque (stenosis) on imaging
  - Heart failure, including heart failure with preserved ejection fraction
  - Peripheral artery disease
  - Atrial fibrillation
  - Severe albuminuria > 300 mg/24 h or ACR (preferably in morning urine) >300 mg/g
  - CKD stage 4 and 5, eGFR < 30 mL/min/1.73m^2

Measurement	Parameter	Abnormality threshold
ECG		
LVH	$S_{V1} + R_{V5}$ (Sokolow–Lyon)	>35 mm
	R wave aVL	≥11 mm
	$S_{V3} + R_{aVL}$ (Cornell voltage)	>28 mm (M), >20 mm (W)
LVH	Cornell voltage (+6 mm in W) × QRS duration (Cornell duration product)	>2440 mm s
ECHO		
LVH	LVM/BSA (g/m^2)	>115 (M), >95 (W)
	LVM/height ($g/m^{2.7}$)	>50 (M), >47 (W)
RWT	LV conc. Remodeling	≥0.43
LV chamber size	LVDDiam/height	>3.4 (M), >3.3 (W) cm/m
LV diastolic dysfunction	*e′* velocity septal	<7 cm/s
	e′ velocity lateral	<10 cm/s
LV filling pressure	*E*/*e′* average ratio	>14
	LAV/BSA	>34 ml/m^2
	LAV/$height^2$	>18.5 (M) or >16.5 (W) ml/m^2
LV systolic dysfunction	GLS	<20%
Kidney		
Function	eGFR	<60 ml/min/1.73 m^2
Albuminuria	UACR	>30 mg/g
Renal resistive index	RRI	>0.7
Large artery stiffness		
Pulse pressure	Brachial PP (>60 years)	≥60 mmHg
Pulse wave velocity	baPWV (in people 60–70 years)	>18 m/s
	cfPWV (in people 50–60 years)	>10 m/s
Carotid atherosclerosis		
	Plaque	IMT ≥1.5 mm, or focal increase in thickness ≥0.5 mm, or 50% of surrounding IMT
	IMT	>0.9 mm
Coronary atherosclerosis		
	CAC	Age-specific and sex-specific reference value
LEAD		


Mid aortic syndrome
Coarctation of aorta
Renal parenchymal disease
Renovascular hypertension – Fibromuscular dysplasia
Renovascular hypertension – Atherosclerotic disease
1–12 yrs
13–18 yrs
19–40 yrs
41–65 yrs
> 65 yrs
Age
Monogenic disorders
Cushing's syndrome
Pheochromocytoma and paraganglioma
Primary aldosteronism


Grade 1 Hypertension BP 140–159/90–99
Grade 2 Hypertension BP 160–179/100–109
Grade 1 Hypertension BP 140–159/90–99
Grade 2 Hypertension BP 160–179/100–109
Grade 3 Hypertension BP ≥/180/110
Asymptomatic, without HMOD and CVD
Symptomatic, or with HMOD, or CKD stage ≥3, or CVD
At least 1 additional office visit (e.g. within 4 weeks)
Diagnosis established – initiate lifestyle interventions
Use HBPM and/or ABPM whenever possible
If <150/95
If ≥150/95
Immediate drug treatment
Initiate drug treatment if BP is not controlled
Aim for optimal BP control at least within 3 months

Lifestyle for BP Control



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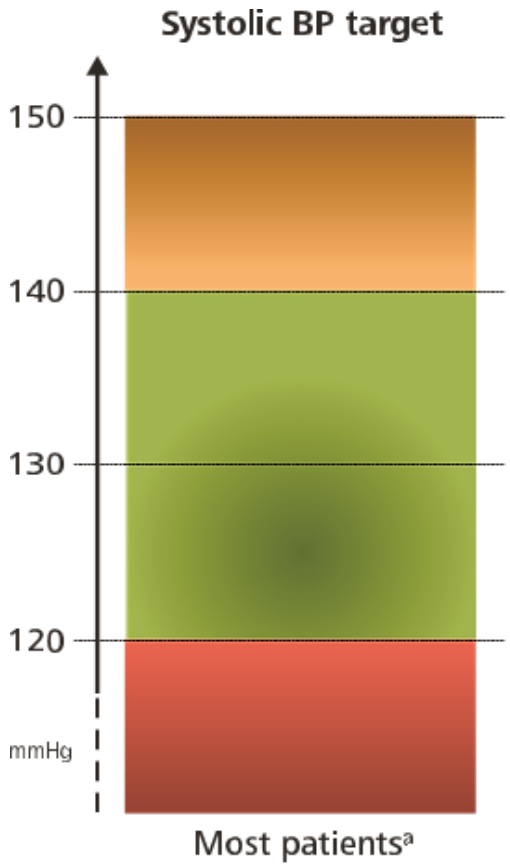

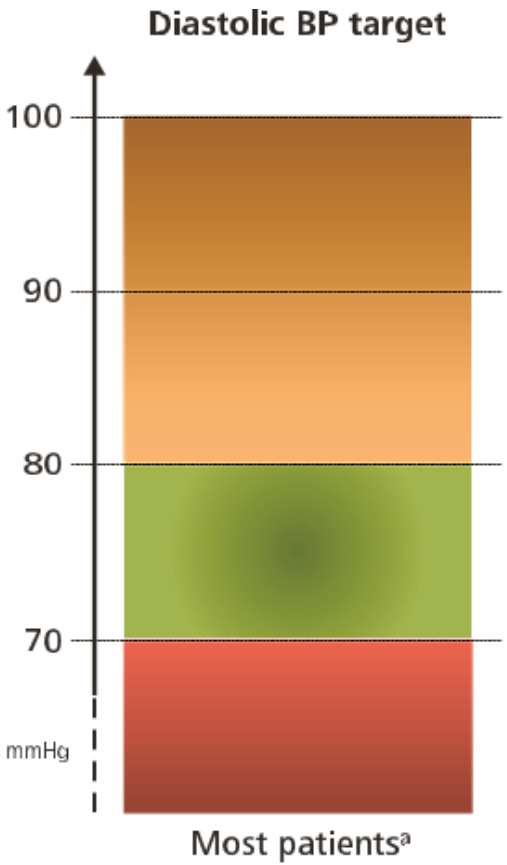

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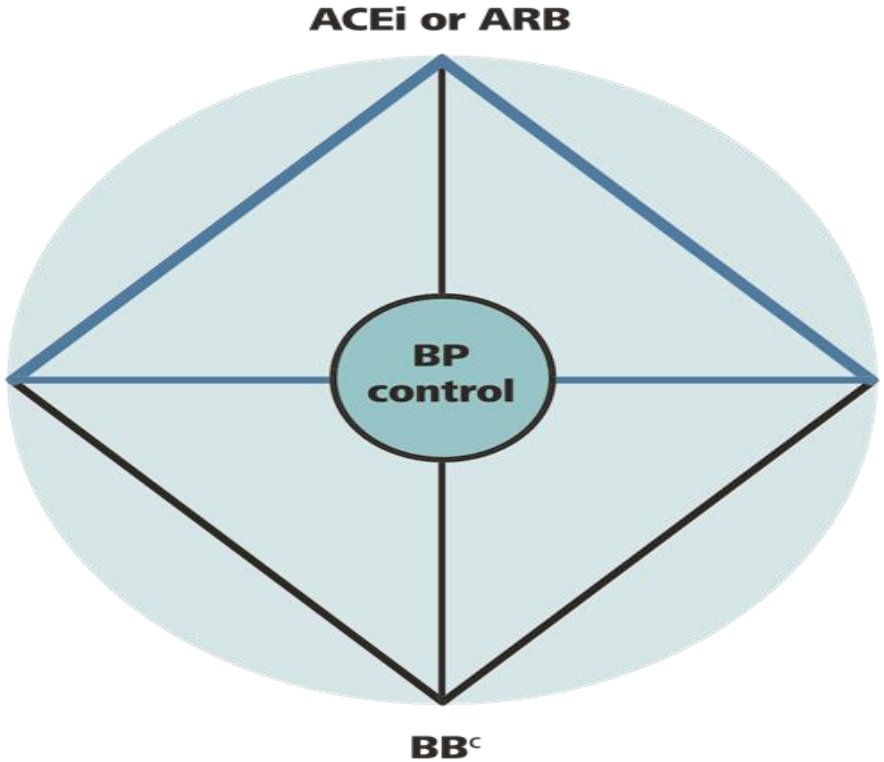
Prescribing patterns:

- Start with dual combination therapy in most patients
- Uptitrate to maximum well tolerated doses and to triple therapy if needed
- **Once daily (preferred in the morning)**
- **Add further drugs if needed**
- **Preferred use of SPCs at any step**



Additional drug classes

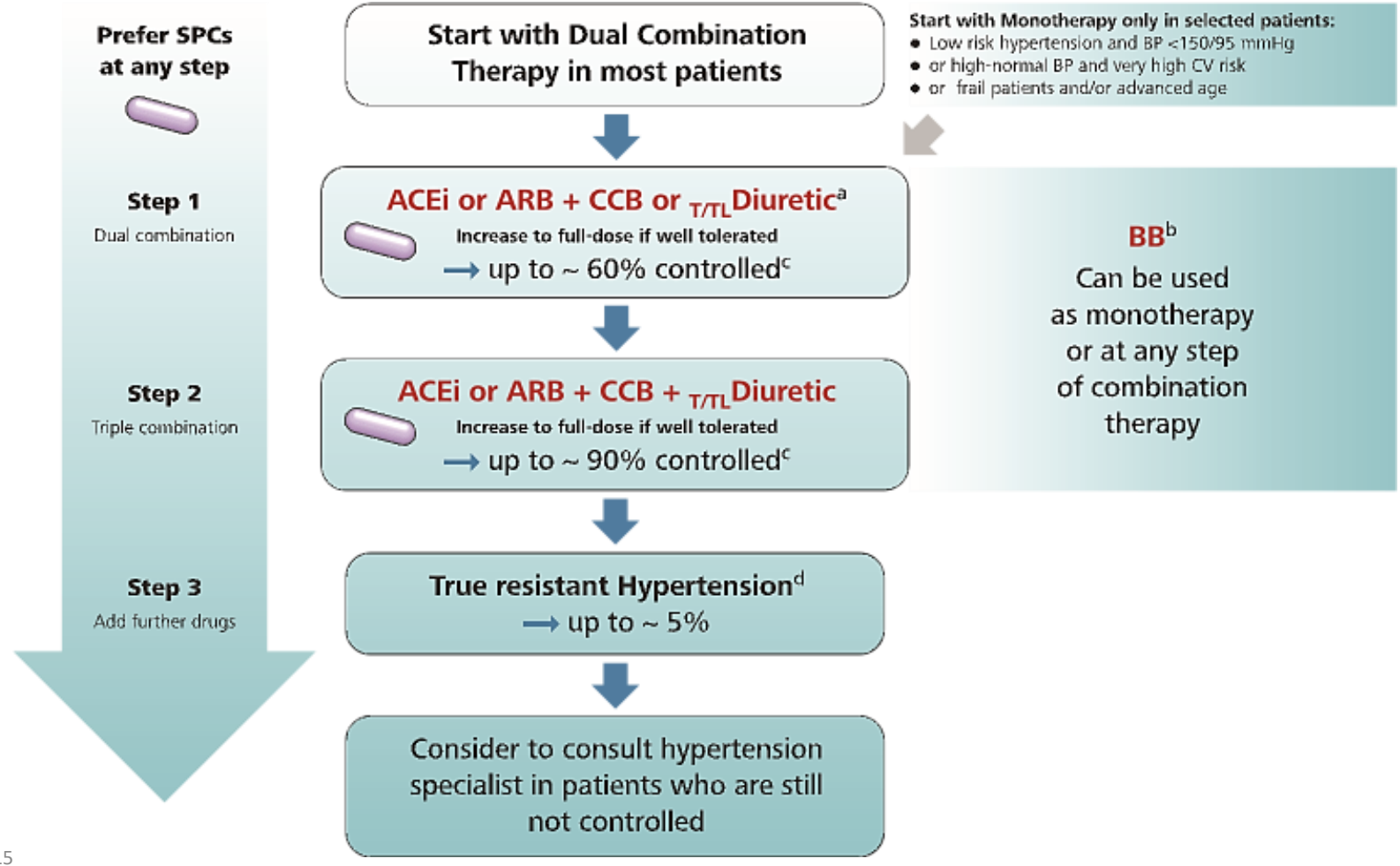
General antihypertensive therapy:

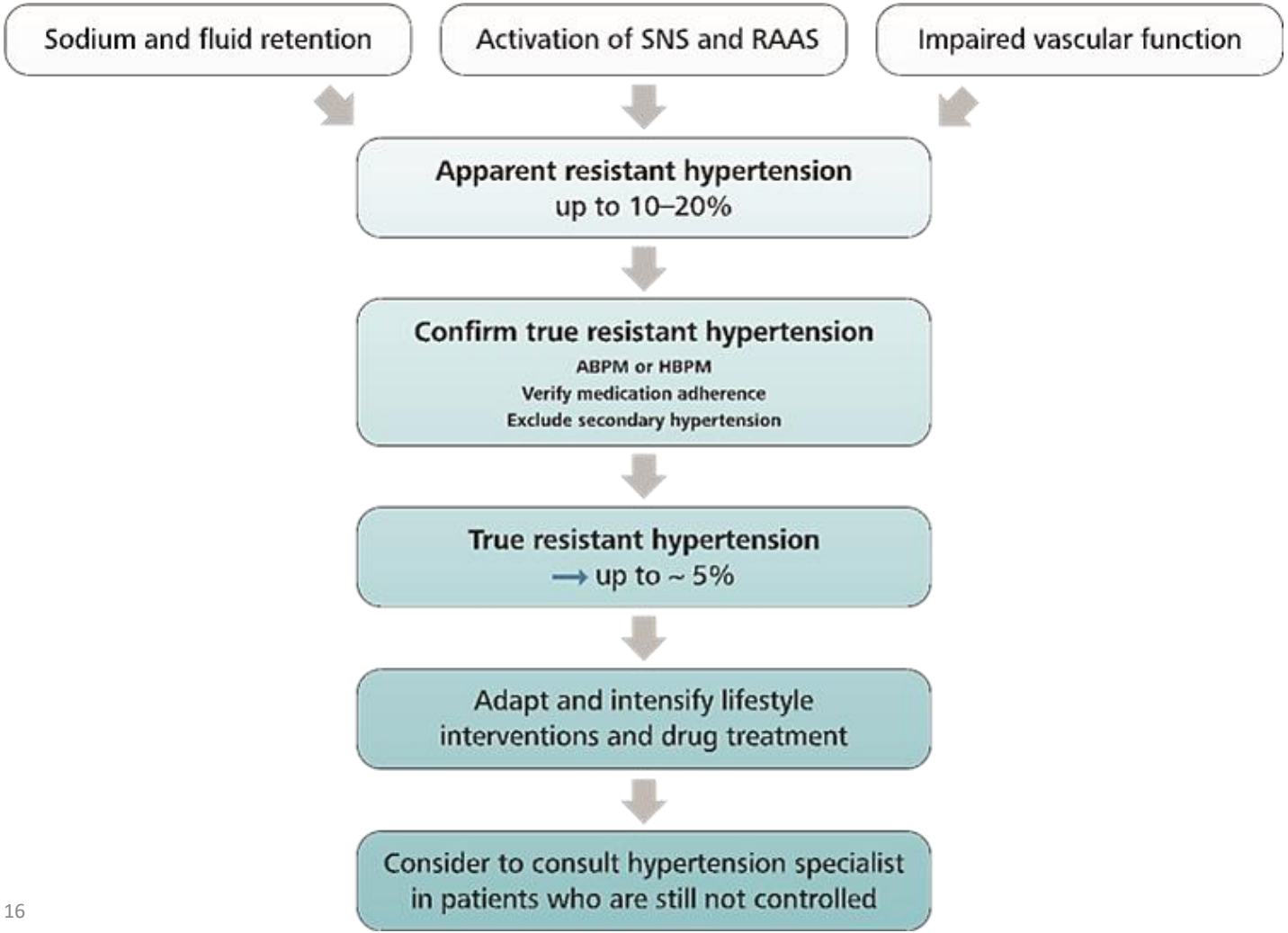
- Steroidal MRA
- Loop Diuretic
- Alpha-1 Blocker
- Centrally acting agent
- Vasodilator

Special comorbidities:

- ARNi
- SGLT2i
- Non-Steroidal MRA

Trial	Comparator	Type of patients	SBP difference (mmHg)	Outcomes (change in relative risk)
ACEi and diuretic combination				
PROGRESS [629]	Placebo	Previous stroke or TIA	−9	−28% strokes (P <0.001)
ADVANCE [630]	Placebo	Diabetes	−5.6	−9% micro/macrovasc. events ($P = 0.04$)
HYVET [502]	Placebo	Hypertensive; ≥80 years	−15	−34% CV events ($P < 0.001$)
ARB and diuretic combination				
SCOPE [631]	Diuretic + placebo	Hypertensive; ≥70 years	−3.2	−28% nonfatal strokes (P = 0.04)
HOPE-3 [492]	Placebo	Patients at intermediate CV risk without CV disease (38% hypertensive patients)	−6	NS overall difference in CV events but -27% in CV events in patients with baseline BP>143.5 mmHg
ARB and CCB				
OSCAR [632]	ARB	Older, high-risk hypertensive patients	−2.4	NS overall difference in CV events -31% events, patients with CV disease (P=0.02)
CCB and diuretic combination				
FEVER [633]	Diuretic + placebo	Hypertensive	−4	−27% CV events ($P < 0.001$)
ACEi and CCB combination				
Syst-Eur [498]	Placebo	Older with ISH	−10	−31% CV events ($P < 0.001$)
Syst-China [145]	Placebo	Older with ISH	−9	−37% CV events ($P < 0.004$)
BB and diuretic combination				
Coope and Warrender [634]	Placebo	Older hypertensive	−18	−42% strokes ($P < 0.03$)
SHEP [635]	Placebo	Older with ISH	−13	−36% strokes ($P < 0.001$)
STOP-Hypertension [636]	Placebo	Older hypertensive	−23	−40% CV events ($P = 0.003$)
STOP-Hypertension 2 [637]	ACEi or conv. antiHT	Hypertensive	0	NS difference in CV events
Combination of two RAS blockers/ACEi + ARB or RAS blocker + renin inhibitor				
ONTARGET [638]	ACE inhibitor or ARB	High-risk patients		More renal events
ALTITUDE [561]	ACE inhibitor or ARB	High-risk diabetic patients		More renal events


Prefer SPCs at any step
Step 1
Dual combination
Step 2
Triple combination
Step 3
Add further drugs
Start with Dual Combination Therapy in most patients
Start with Monotherapy only in selected patients:
• Low risk hypertension and BP <150/95 mmHg
• or high-normal BP and very high CV risk
• or frail patients and/or advanced age
ACEi or ARB + CCB or T/TL Diuretic[a]
Increase to full-dose if well tolerated
→ up to ~ 60% controlled[c]
ACEi or ARB + CCB + T/TL Diuretic
Increase to full-dose if well tolerated
→ up to ~ 90% controlled[c]
BB[b]
Can be used as monotherapy or at any step of combination therapy
True resistant Hypertension[d]
→ up to ~ 5%
Consider to consult hypertension specialist in patients who are still not controlled


Sodium and fluid retention
Activation of SNS and RAAS
Impaired vascular function
Apparent resistant hypertension
up to 10–20%
Confirm true resistant hypertension
ABPM or HBPM
Verify medication adherence
Exclude secondary hypertension
True resistant hypertension
→ up to ~ 5%
Adapt and intensify lifestyle interventions and drug treatment
Consider to consult hypertension specialist in patients who are still not controlled

Lifestyle Interventions

Weight Reduction
Diet – DASH, Mediterranean, Salt restriction, Coffee
Exercise
Reduce alcohol intake
Sleep Hygiene, Secondary causes (OSA)
Stress management (First Beat)

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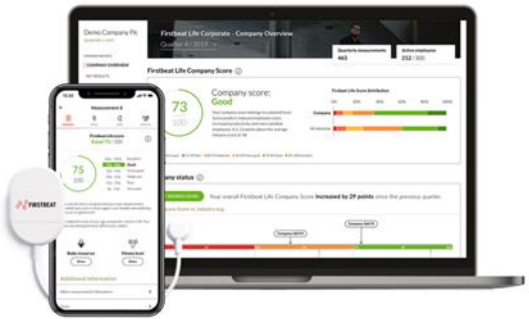
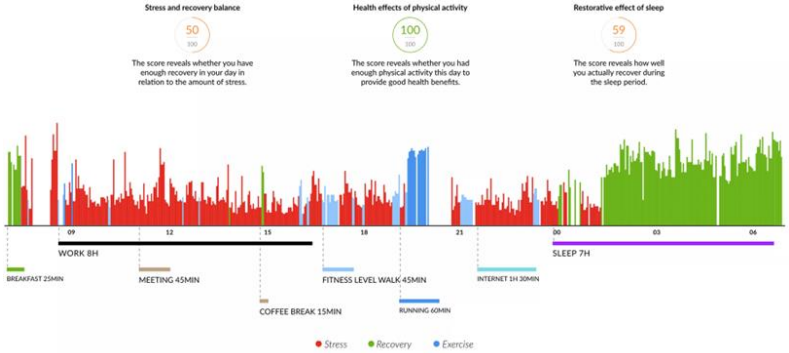
Lifestyle Heart Health
Improvement Programs





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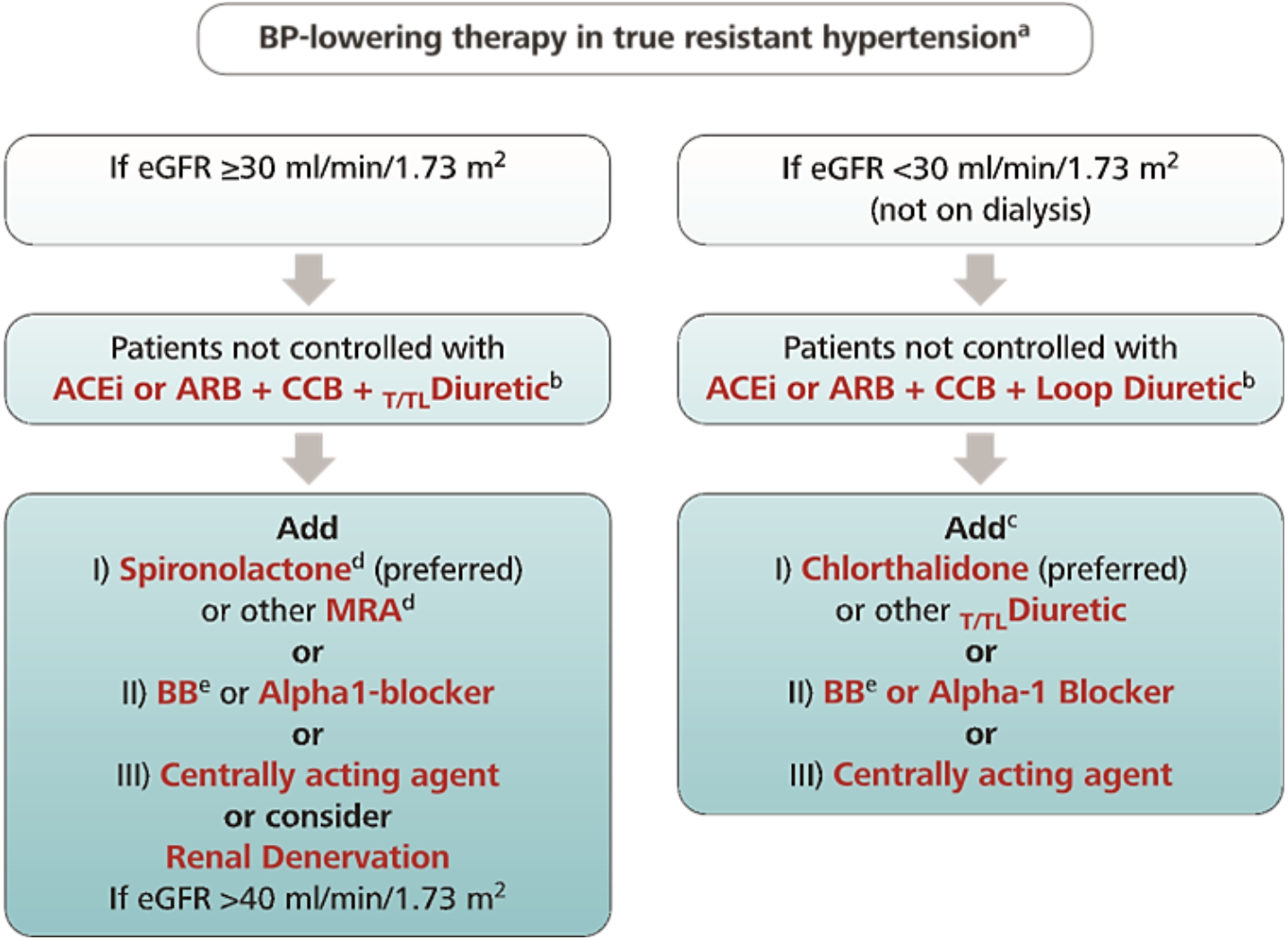
BP-lowering therapy in true resistant hypertension[a]
If eGFR ≥30 ml/min/1.73 m²
Patients not controlled with
ACEi or ARB + CCB + T/TL Diuretic[b]
Add
I) Spironolactone[d] (preferred)
or other MRA[d]
or
II) BB[e] or Alpha1-blocker
or
III) Centrally acting agent
or consider
Renal Denervation
If eGFR >40 ml/min/1.73 m²
If eGFR <30 ml/min/1.73 m²
(not on dialysis)
Patients not controlled with
ACEi or ARB + CCB + Loop Diuretic[b]
Add[c]
I) Chlorthalidone (preferred)
or other T/TL Diuretic
or
II) BB[e] or Alpha-1 Blocker
or
III) Centrally acting agent

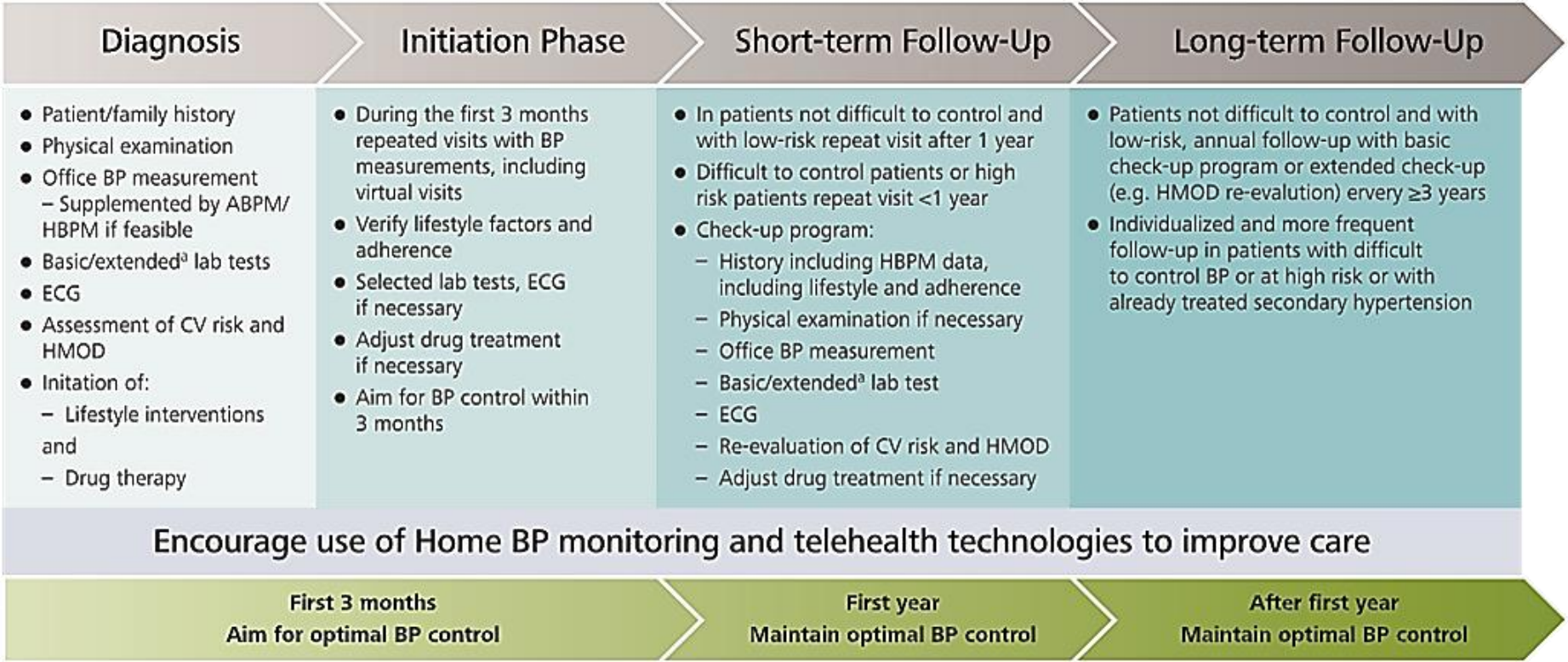

FIGURE 21 Follow-up of patients with hypertension.

Bottom Line

- Check office / ABPM
- Clinical history, exam, bloods, urine, renal ultrasound
- Start with lifestyle (and meds if high risk)
- Aim is optimum control, irrespective of medication picked
- Combination more effective than single
- Quarterly monitoring until controlled. Lifelong measures, especially with stroke, AF, CKD, MI, Premature death risks.
- Difficult to control – optimise all measures / refer
- Special considerations – pregnancy, elderly, aortic stenosis, Eyes

Useful Reference

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2023 ESH Guidelines for the management of
arterial hypertension
The Task Force for the management of arterial hypertension
of the European Society of Hypertension
Journal of Hypertension Dec 2023

Thank you

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