# High Blood Pressure

## What is It? How to Check?
## What Can Go Wrong....?
## How to treat?

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Barts HealthTrust

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# Declaration of interest

- None to declare

Public Health England

# Healthmatters High blood pressure in England

High blood pressure affects **more than 1 in 4** adults in England

High blood pressure is the **3rd biggest risk factor** for premature death and disability in England after smoking and poor diet


People from the most deprived areas in England are **30%** more likely than the least-deprived to have high blood pressure


**At least half** of all heart attacks and strokes are associated with high BP and it is a major risk factor for chronic kidney disease, heart failure and dementia

# *"What's wrong with high blood pressure – I think mine is ok"*

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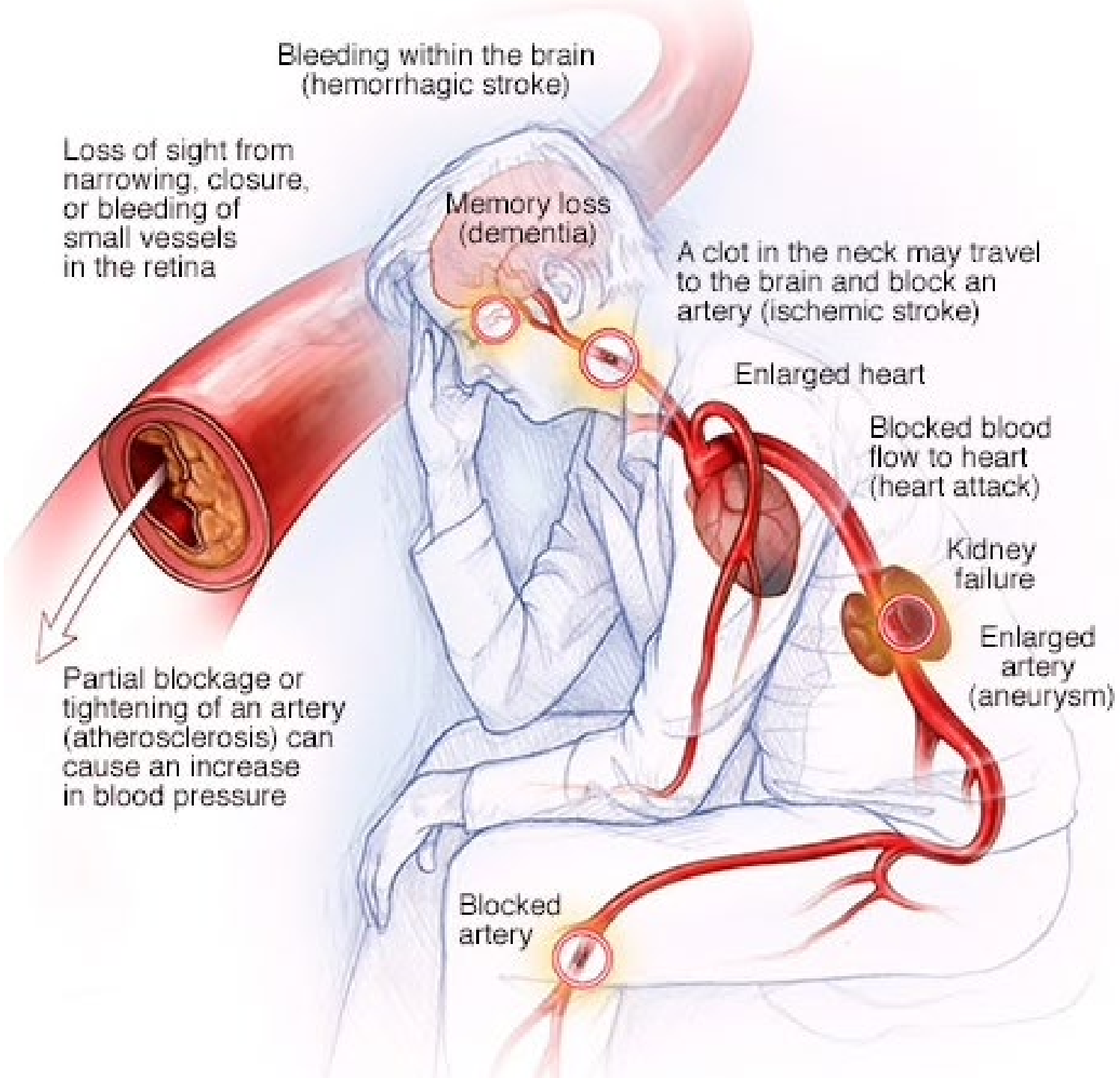
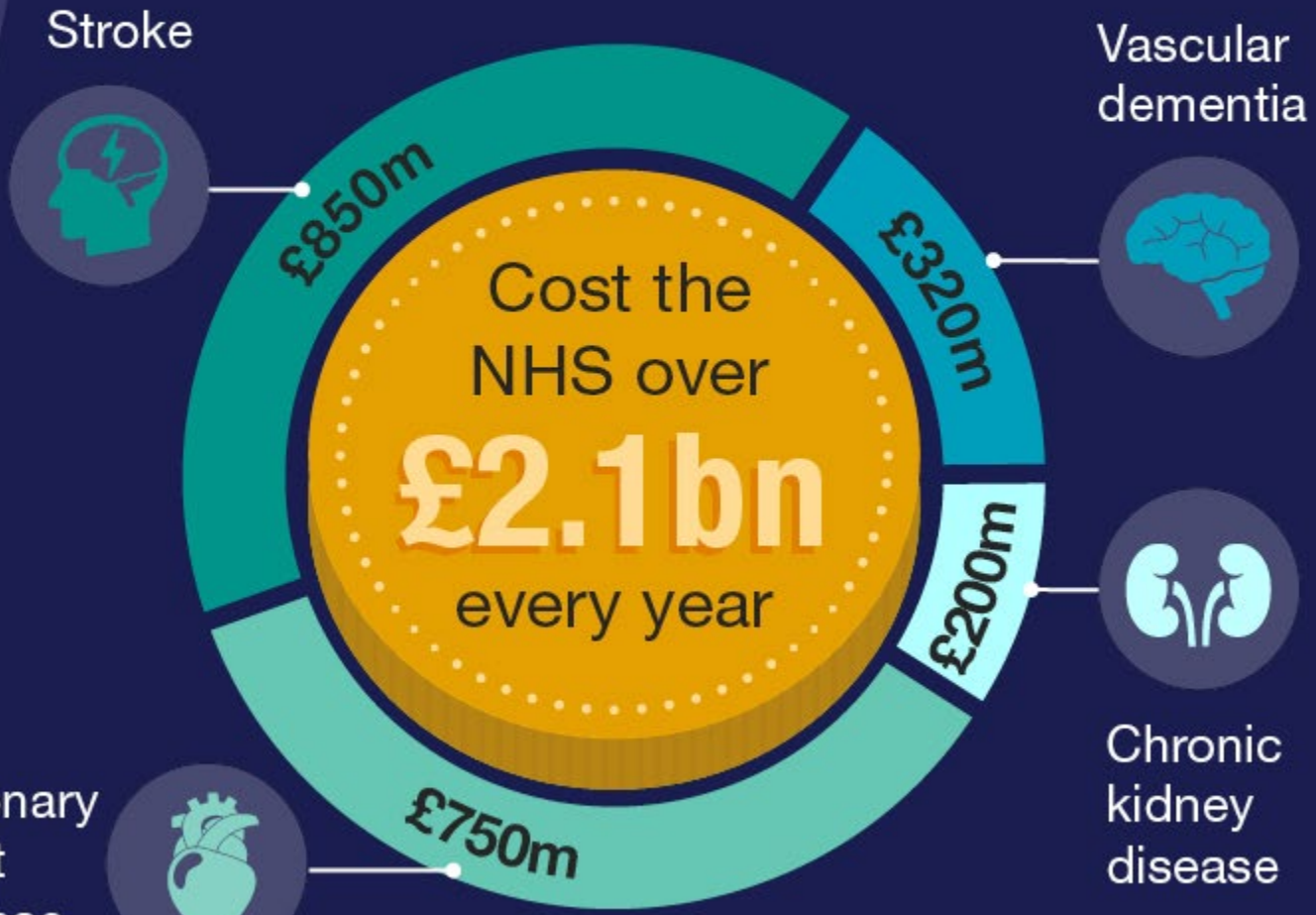

Bleeding within the brain
(hemorrhagic stroke)
Loss of sight from narrowing, closure, or bleeding of small vessels in the retina
Memory loss (dementia)
A clot in the neck may travel to the brain and block an artery (ischemic stroke)
Enlarged heart
Blocked blood flow to heart (heart attack)
Kidney failure
Enlarged artery (aneurysm)
Partial blockage or tightening of an artery (atherosclerosis) can cause an increase in blood pressure
Blocked artery

# Diseases caused by high blood pressure:



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# DALYs Attributable to 20 Risk Factors (UK)

**Global Burden of Disease Study. Lancet 2013;381:997-1020**

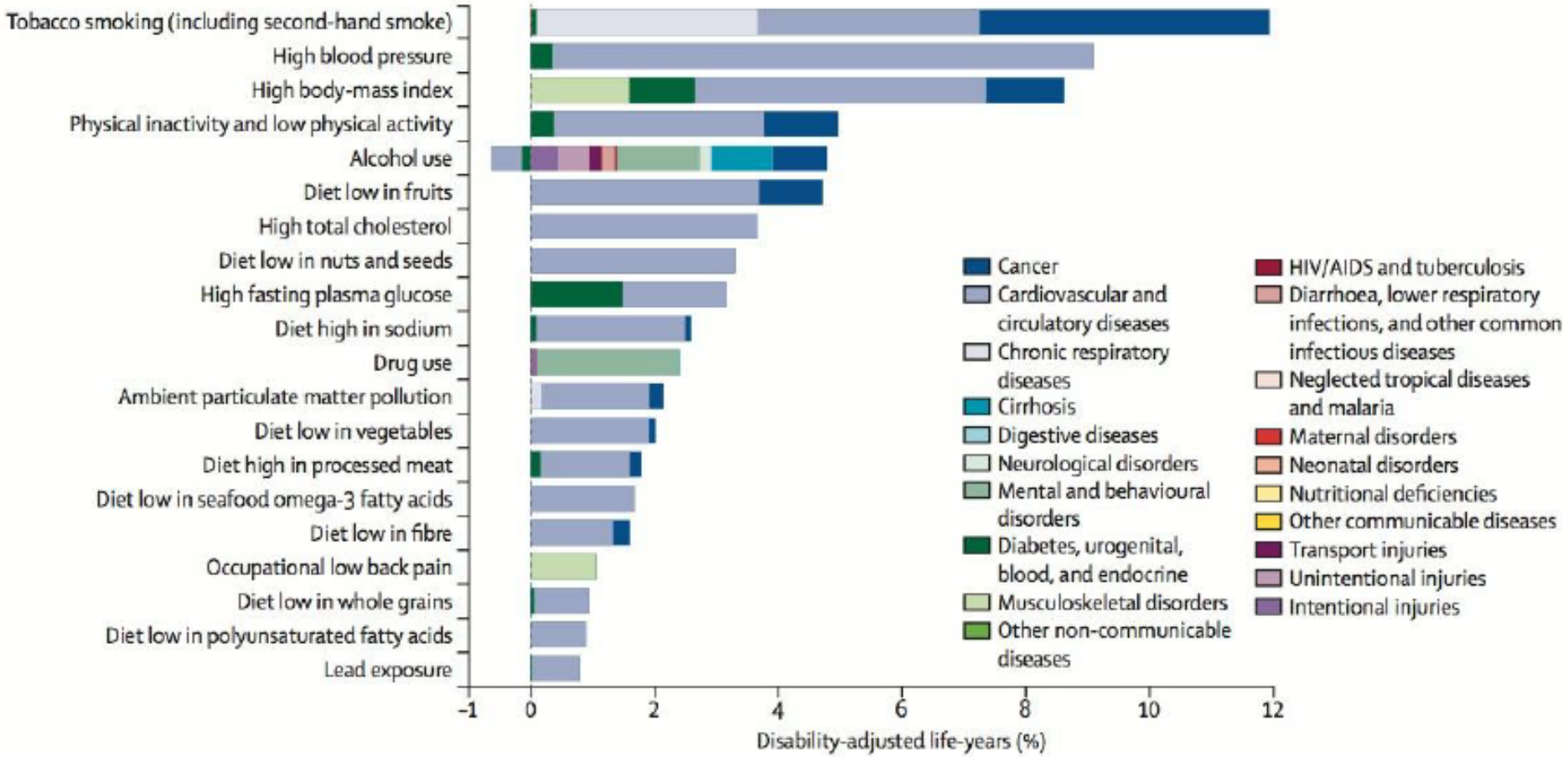



***Figure 7*: Burden of disease attributable to 20 leading risk factors for both sexes in 2010, expressed as a percentage of UK disability-adjusted life-years**
The negative percentage for alcohol is the protective effect of mild alcohol use on ischaemic heart disease and diabetes.

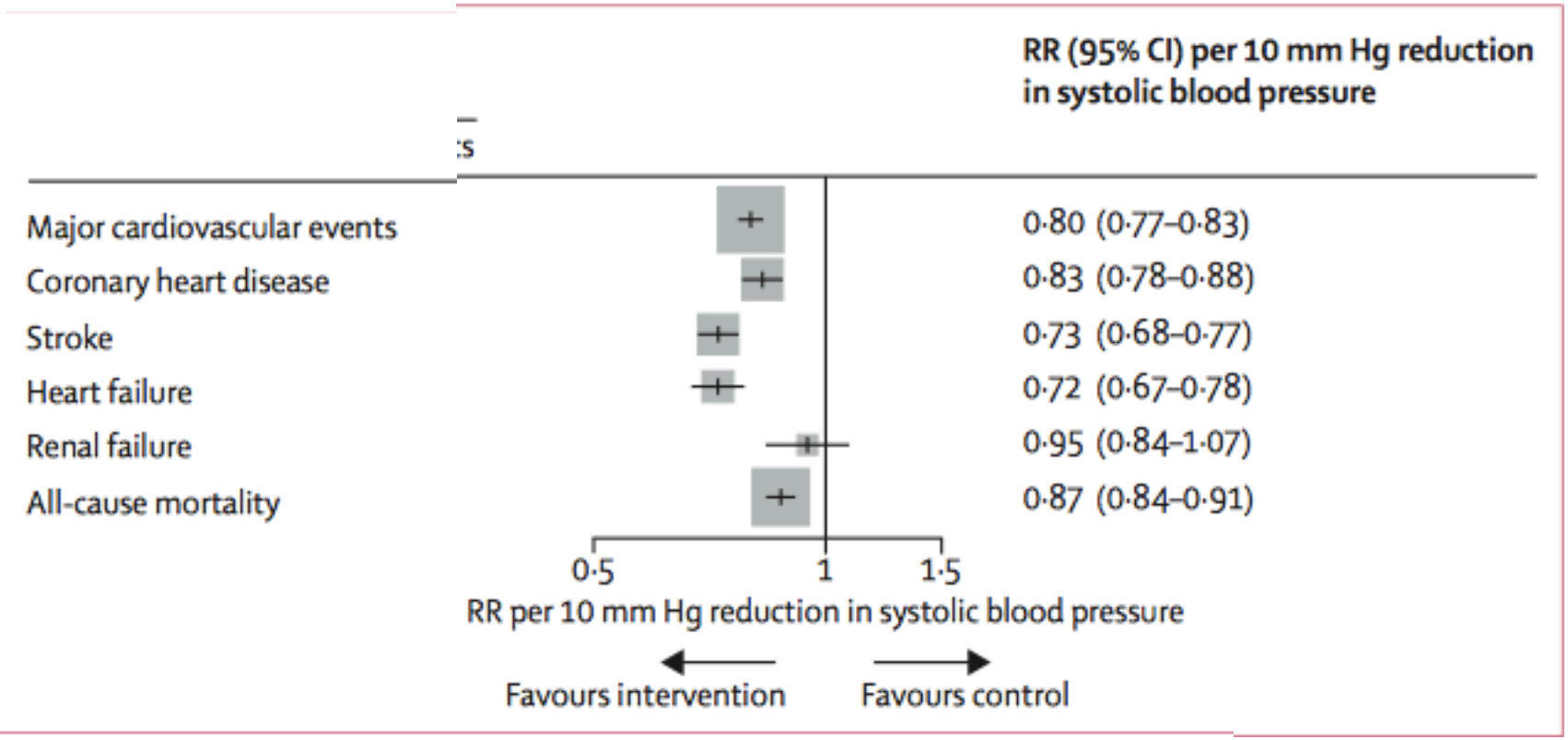
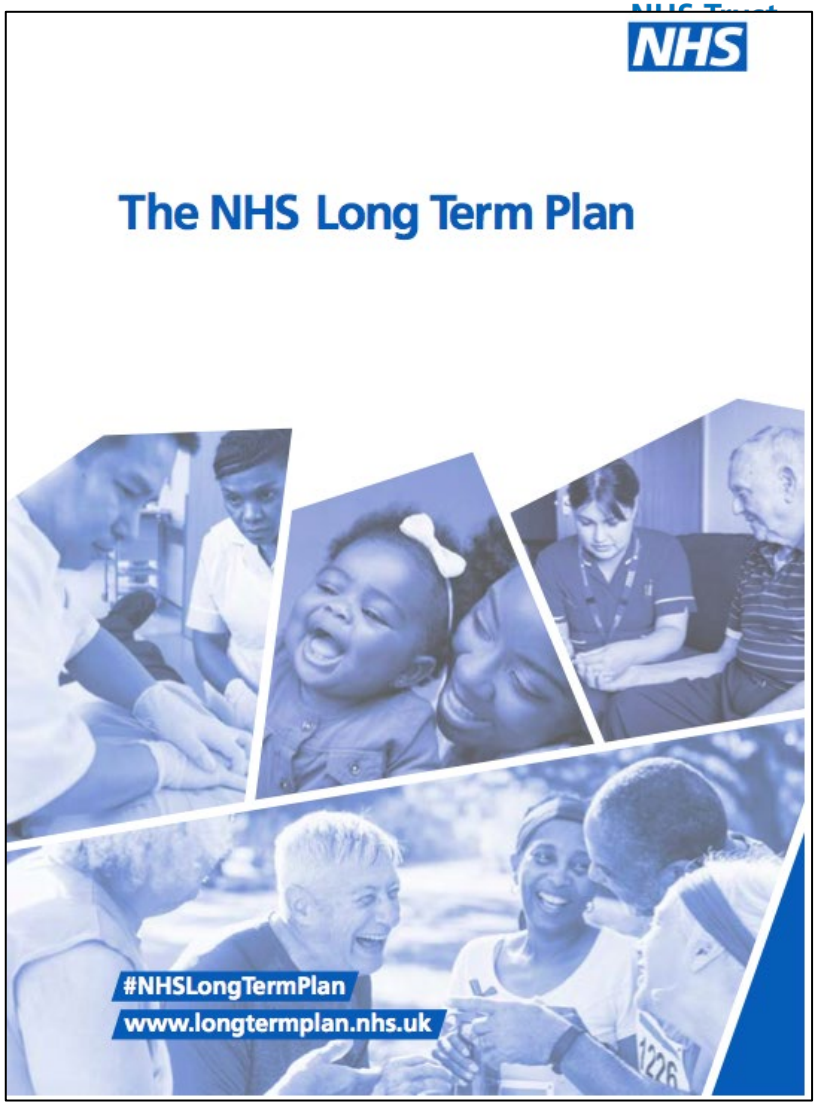



***Figure 3*: Standardised effects of a 10 mm Hg reduction in systolic blood pressure**
RR=relative risk.

*Lancet* 2016; 387: 957–67

- The NHS Long term plan is a new plan for the NHS to improve the quality of patient care and health outcomes.
- It sets out how the £20.5 billion budget settlement for the NHS , announced by the prime minister in summer 2018 will be spent over the next 5 years
- The plan focuses on building an NHS fit for the future by:
  - enabling everyone to get the best start in life
  - helping communities to live well
  - helping people to age well



# The Size of the Prize in Cardiovascular Disease (CVD) Prevention

## England

Public Health England

NHS England

### 1. The diagnosis and treatment gap

| | | |
|---|---|---|
| Hypertension | Estimated adult population with hypertension | 13,550,700 |
| | Estimated adult population with undiagnosed hypertension | 5,601,600 |
| | GP registered hypertensives not treated to 150/90 mmHg target | 1,618,900 |
| Atrial Fibrillation (AF) | GP registered population with Atrial Fibrillation (AF) | 983,300 |
| | Estimated GP registered population with undiagnosed AF | 422,600 |
| | GP registered high risk AF patients (CHA2DS2VASc >=2) not anticoagulated | 177,800 |
| CVD risk | Estimated adult population 30 to 85 years with 10 year CVD risk >20% | 3,960,200 |
| | Estimated percentage of people with CVD risk ≥20% treated with statins | 49 |

### 2. The burden: first ever CVD events

| | |
|---|---|
| Coronary Heart disease | 128,750 |
| Stroke | 66,450 |
| Heart Failure | 48,350 |

### 3. The opportunity: potential events averted and savings over 3 years by optimising treatment in AF and hypertension

| | | |
|---|---|---|
| Optimal anti-hypertensive treatment of diagnosed hypertensives averts within 3 years: | 9,710 heart attacks | Up to £72.5 million saved |
| | 14,500 strokes | Up to £201.7 million saved |
| Optimally treating high risk AF patients averts within 3 years: | 14,220 strokes | Up to £241.6 million saved |

# Multiple Risk Factors

- There are two other important cardiovascular risk factors
  - raised blood lipids - hyperlipidaemia
  - smoking

all three factors have a multiplicative effect on each other

# How do we diagnose hypertension?

- **Clinic Blood Pressure Checks**
  - 2 or 3 readings on each occasion & take average
  - Repeated monthly for 3 months
  - If persistently above 140/90mmHg
    = HYPERTENSION

- Diagnosis – The Old Way…

- **Initial Clinic BP measurement (CBPM)**
  - If > 140/90mmHg;
  - refer for either:
- Ambulatory Blood Pressure Monitor (ABPM) or Home BP monitoring (HBPM)
  - If BP > 135/85mmHg = HYPERTENSION

- Diagnosis – NICE 2011

# ABPM

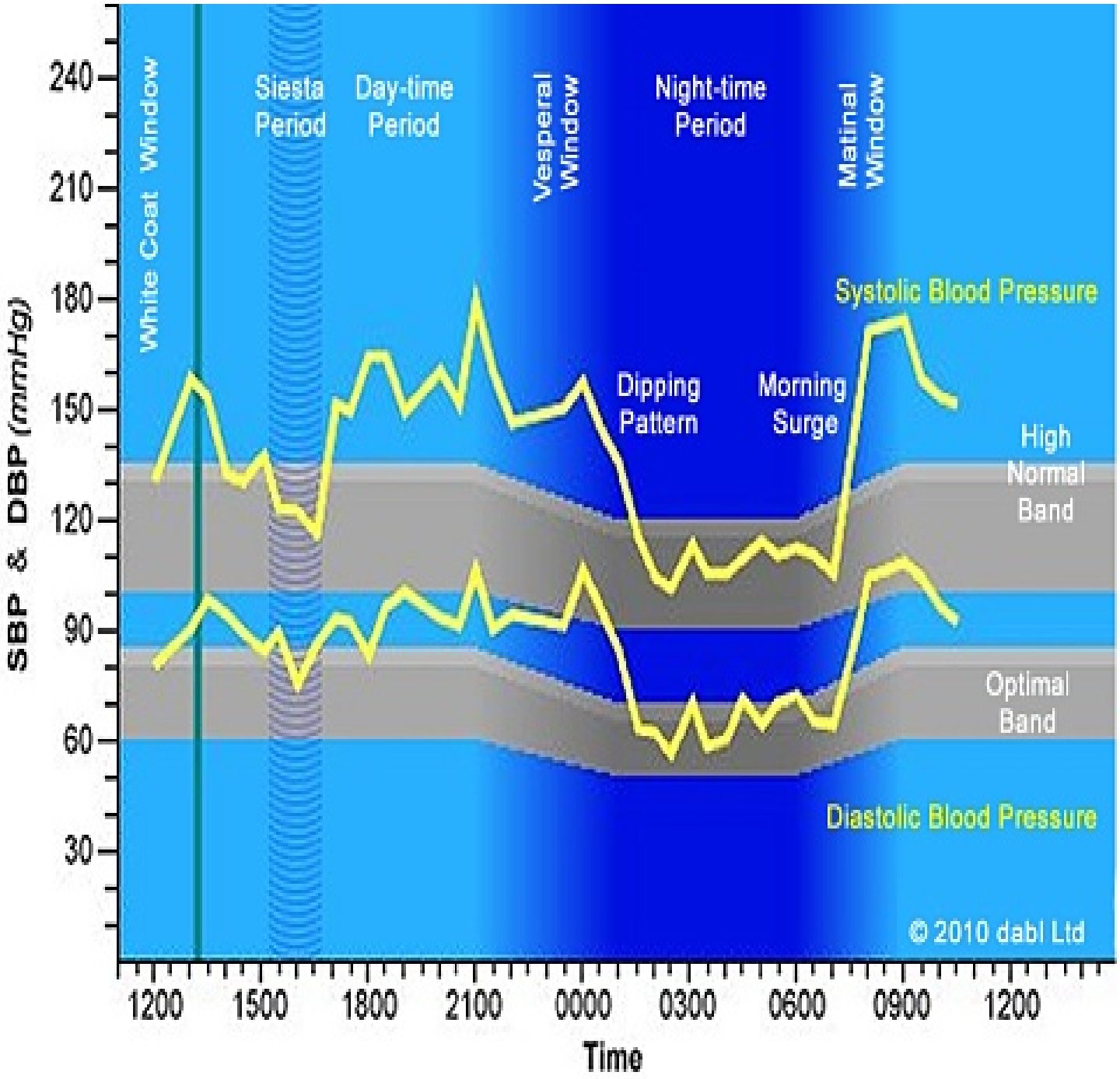
- 24 hour BP monitor
- Readings every half an hour throughout the day, and hourly overnight
- Atleast 14 measurements to confirm dx
- Average of daytime readings used to assess BP for diagnosis
- If > 135/85mmHg = hypertension
- Will reduce number of patients with white coat hypertension being treated

# Home BP monitoring

- Patients loaned a calibrated BP machine
- Takes readings twice daily for 7 days and records results
- Discard first days results and calculate average of all other readings
- If BP > 135/85 = Hypertension

# Do you always follow proper BP measurement technique?

- Environment: quiet, comfortable location at normal room temperature
- Patient:
  - ✓ not needing to pass urine, not recently eaten, smoked or taken caffeine or exercise for at least 30mn before
  - ✓ Seated calmly for 5mn, back supported and feet flat on the floor,
  - ✓ Arm: out-stretched, in line with mid-sternum and supported
- Select cuff size
- Initial BP check: in **both arms**
  - ✓ BP difference of <10mmHg normal
  - ✓ If difference >20 mmHg, repeat measurements
  - ✓ *use the arm with **the higher reading** for subsequent BP measurements*
- Subsequent BP check:
  - ✓ 2 readings, at least 1mn apart,
  - ✓ If more than 5mmHg difference take at least one additional reading, ?average the 2 best readings
- If pulse irregular check BP manually

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Date-of-Birth: 07/08/1970
Age: 45 Years
Medications: Dose: Time:

Weight:
Race: Unspecified
Physician: admin,admin
Nurse/Technician:
Duration: 21:55
Scan Start: 08/03/2016 13:10 Tue
Scan End: 09/03/2016 11:05 Wed
Successful Reading(s): 35 90%
Indications:

## Overall Summary

| | AVG | STD | | MIN | MAX | Dipping |
|---|---|---|---|---|---|---|
| Systolic: | 128 | 15.61 | mmHg | 88 (11:05 Wed) | 154 (21:05 Tue) | -5.5% |
| Diastolic: | 81 | 13.66 | mmHg | 49 (16:35 Tue) | 104 (20:38 Tue) | -11.3% |
| MAP: | 97 | 15.13 | mmHg | 56 | 130 | -9.5% |
| Pulse Pressure: | 46 | 9.19 | mmHg | 29 | 73 | |
| Heart Rate: | 91 | 8.81 | bpm | 73 | 106 | |

| | Reading(s) | Time |
|---|---|---|
| Percent of Systolic above limits: | 45.7% | 52.2% |
| Percent of Diastolic above limits: | 51.4% | 56.8% |

## Wake Period(s) 06:00 - 22:00

| | AVG | STD | | MIN | MAX |
|---|---|---|---|---|---|
| Systolic: | 126 | 17.47 | mmHg | 88 (11:05 Wed) | 154 (21:05 Tue) |
| Diastolic: | 79 | 14.46 | mmHg | 49 (16:35 Tue) | 104 (20:38 Tue) |
| MAP: | 94 | 16.55 | mmHg | 56 | 130 |
| Pulse Pressure: | 47 | 10.14 | mmHg | 29 | 73 |
| Heart Rate: | 91 | 9.89 | bpm | 73 | 106 |

| | Reading(s) | Time |
|---|---|---|
| Percent of Systolic readings > 135mmHg: | 30.8% | 39.2% |
| Percent of Diastolic readings > 85mmHg: | 34.6% | 35.5% |

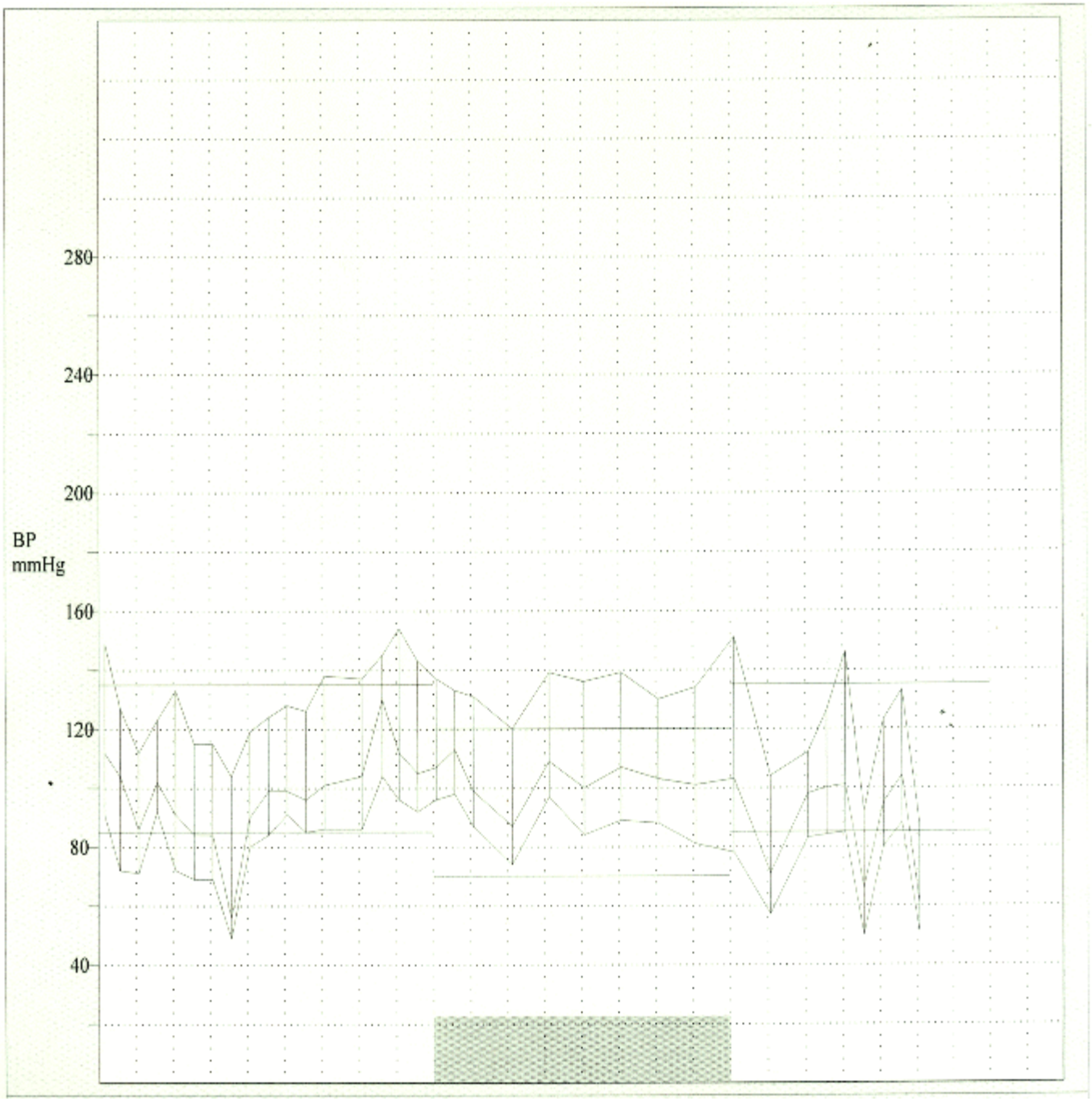
Number of Wake Period(s) readings: 26

## Sleep Period(s) 22:00 - 06:00

| | AVG | STD | | MIN | MAX |
|---|---|---|---|---|---|
| Systolic: | 133 | 5.91 | mmHg | 120 (00:08 Wed) | 139 (01:08 Wed) |
| Diastolic: | 88 | 7.97 | mmHg | 74 (00:08 Wed) | 98 (22:35 Tue) |
| MAP: | 103 | 7.52 | mmHg | 87 | 113 |
| Pulse Pressure: | 45 | 5.85 | mmHg | 35 | 53 |
| Heart Rate: | 90 | 4.82 | bpm | 85 | 101 |

| | Reading(s) | Time |
|---|---|---|
| Percent of Systolic readings > 120mmHg: | 88.9% | 85.2% |
| Percent of Diastolic readings > 70mmHg: | 100% | 100% |

Number of Sleep Period(s) readings: 9

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# Epworth sleepiness scale

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Use the following scale to choose the most appropriate number for each situation:-

0 = would never doze
1 = Slight chance of dozing
2 = Moderate chance of dozing
3 = High chance of dozing

| **Situation** | **Chance of dozing** |
|---|---|
| Sitting and reading | |
| Watching TV | |
| Sitting, inactive in a public place (e.g. a theatre or a meeting) | |
| As a passenger in a car for an hour without a break | |
| Lying down to rest in the afternoon when circumstances permit | |
| Sitting and talking to someone | |
| Sitting quietly after a lunch without alcohol | |
| In a car, while stopped for a few minutes in the traffic | |
| **Total** | |

Score:

0 – 10 Normal range
10 – 12 Borderline
12 – 24 Abnormal

# Office BP measurement - 1

| |
|---|
| Patients should be seated comfortably in a quiet environment for 5 min before beginning BP measurements. |
| Three BP measurements should be recorded, 1–2 min apart, and additional measurements only if the first two readings differ by > 10 mmHg.<br>BP is recorded as the average of the last two BP readings. |
| Additional measurements may have to be performed in patients with unstable BP values due to arrhythmias, such as in patients with AF, in whom manual auscultatory methods should be used as most automated devices have not been validated for BP measurement in patients with AF. |
| Use a standard bladder cuff (12–13 cm wide and 35 cm long) for most patients, but have larger and smaller cuffs available for larger (arm circumference > 32 cm) and thinner arms, respectively. |
| The cuff should be positioned at the level of the heart with the back and arm supported, to avoid muscle contraction and isometric-exercise dependent increases in BP. |

Williams, Mancia et al., J Hypertens 2018;36:1953-2041 and Eur Heart J 2018;39:3021-3104

# Diagnosis (3)

**1.2.2**

Record the lower of the last two measurements as the clinic blood pressure

# Office BP measurement - 1

| |
|---|
| Patients should be seated comfortably in a quiet environment for 5 min before beginning BP measurements. |
| Three BP measurements should be recorded, 1–2 min apart, and additional measurements only if the first two readings differ by > 10 mmHg.<br>BP is recorded as the average of the last two BP readings. |
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| The cuff should be positioned at the level of the heart with the back and arm supported, to avoid muscle contraction and isometric-exercise dependent increases in BP. |

Williams, Mancia et al., J Hypertens 2018;36:1953-2041 and Eur Heart J 2018;39:3021-3104

# Office BP measurement - 2

When using auscultatory methods, use phase I and V (sudden reduction/disappearance) Korotkoff sounds to identify SBP and DBP, respectively.

Measure BP in both arms at the first visit to detect possible between-arm differences.

Use the arm with the higher value as the reference.

Measure BP 1 minute and 3 min after standing from seated position in all patients

at the first measurement to exclude orthostatic hypotension.

Lying and standing BP measurements should also be considered in subsequent visits in older people, in people with diabetes, and in other conditions in which

orthostatic hypotension may frequently occur.

Record heart rate and use pulse palpation to exclude arrhythmia.

Williams, Mancia et al., J Hypertens 2018;36:1953-2041 and Eur Heart J 2018;39:3021-3104

# BP measurement - 3

| Recommendations | Class | Level |
|---|---|---|
| It is recommended that office BP should be measured in both arms at least at the first visit because a between-arm SBP difference of > 15 mmHg is suggestive of atheromatous disease and is associated with an increased CV risk. | I | A |

Williams, Mancia et al., J Hypertens 2018;36:1953-2041 and Eur Heart J 2018;39:3021-3104

# Office BP measurement - 2

| |
|---|
| When using auscultatory methods, use phase I and V (sudden reduction/disappearance) Korotkoff sounds to identify SBP and DBP, respectively. |
| Measure BP in both arms at the first visit to detect possible between-arm differences.<br>Use the arm with the higher value as the reference. |
| Measure BP 1 minute and 3 min after standing from seated position in all patients<br>at the first measurement to exclude orthostatic hypotension.<br>Lying and standing BP measurements should also be considered in subsequent visits in older people, in people with diabetes, and in other conditions in which<br>orthostatic hypotension may frequently occur. |
| Record heart rate and use pulse palpation to exclude arrhythmia. |

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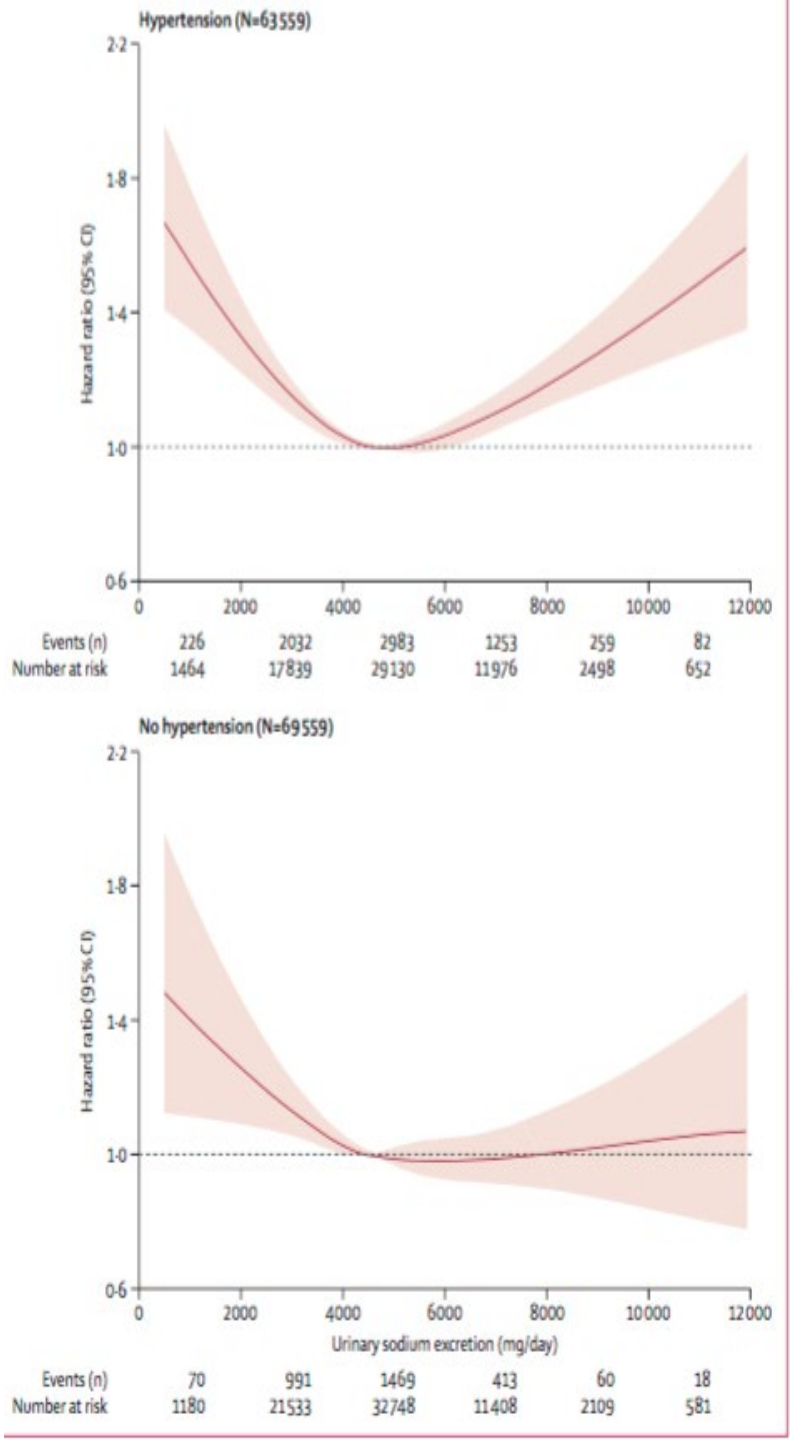
# NON PHARMACOLOGICAL MEASURES

# Non-Pharmacological Measures

- Diet
- Lifestyle
  - weight reduction
  - salt reduction
  - moderate alcohol intake
  - exercise
  - smoking cessation
  - cholesterol lowering

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# Associations of urinary sodium excretion with cardiovascular events in individuals with and without hypertension: a pooled analysis of data from four studies

Andrew Mente, Martin O'Donnell, Sumathy Rangarajan, Gilles Dagenais, Scott Lear, Matthew McQueen, Rafael Diaz, Alvaro Avezum, Patricio Lopez-Jaramillo, Fernando Lanas, Wei Li, Yin Lu, Sun Yi, Lei Rensheng, Romaina Iqbal, Prem Mony, Rita Yusuf, Khalid Yusoff, Andrzej Szuba, Aytekin Oguz, Annika Rosengren, Ahmad Bahonar, Afzalhussein Yusufali, Aletta Elisabeth Schutte, Jephat Chifamba, Johannes F E Mann, Sonia S Anand, Koon Teo, S Yusuf, for the PURE, EPIDREAM, and ONTARGET/TRANSCEND Investigators

Lancet 2016; 388: 465-75

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# Lifestyle modifications

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| Modification | Recommendation | Approximate SBP Reduction (Range)† |
|---|---|---|
| Weight reduction | Maintain normal body weight (body mass index 18.5–24.9 kg/m²). | 5–20 mmHg/10kg[92,93] |
| Adopt DASH eating plan | Consume a diet rich in fruits, vegetables, and lowfat dairy products with a reduced content of saturated and total fat. | 8–14 mmHg[94,95] |
| Dietary sodium reduction | Reduce dietary sodium intake to no more than 100 mmol per day (2.4 g sodium or 6 g sodium chloride). | 2–8 mmHg[94-96] |
| Physical activity | Engage in regular aerobic physical activity such as brisk walking (at least 30 min per day, most days of the week). | 4–9 mmHg[97-98] |
| Moderation of alcohol consumption | Limit consumption to no more than 2 drinks (e.g., 24 oz beer, 10 oz wine, or 3 oz 80-proof whiskey) per day in most men, and to no more than 1 drink per day in women and lighter weight persons. | 2–4 mmHg[99] |

www.nhlbi.nih.gov

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# What to do while your waiting!

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- Test for presence of protein in the urine
- Take a blood sample to measure
  - Glycated haemoglobin (HbA1C),
  - Electrolytes,
  - Creatinine,
  - Estimated glomerular filtration rate,
  - Total cholesterol and HDL cholesterol
- Examine the fundi for the presence of hypertensive retinopathy
- Arrange for a 12-lead electrocardiograph to be performed.

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# And while your waiting for these results to come back ……

ClinRisk

# Welcome to the QRISK®3-2018 risk calculator https://qrisk.org/three

This calculator is only valid if you do not already have a diagnosis of coronary heart disease (including angina or heart attack) or stroke/transient ischaemic attack.



About you

Age (25-84): 64

Sex: (•) Male ( ) Female

Ethnicity: White or not stated

UK postcode: leave blank if unknown

Postcode:

Clinical information

Smoking status: non-smoker

Diabetes status: none

Angina or heart attack in a 1st degree relative < 60? ☐

Chronic kidney disease (stage 3, 4 or 5)? ☐

Atrial fibrillation? ☐

On blood pressure treatment? ☐

Do you have migraines? ☐

Rheumatoid arthritis? ☐

Systemic lupus erythematosus (SLE)? ☐

Severe mental illness? ☐
(this includes schizophrenia, bipolar disorder and moderate/severe depression)

On atypical antipsychotic medication? ☐

Are you on regular steroid tablets? ☐

A diagnosis of or treatment for erectile disfunction? ☐

Leave blank if unknown

## Welcome to the QRISK®3-2018 risk calculator

Welcome to the QRISK®3-2018 Web Calculator. The QRISK®3 algorithm calculates a person's risk of developing a heart attack or stroke over the next 10 years. It presents the average risk of people with the same risk factors as those entered for that person.

The QRISK®3 algorithm has been developed by doctors and academics working in the UK National Health Service and is based on routinely collected data from many thousands of GPs across the country who have freely contributed data to the QResearch database for medical research.

QRISK®3 has been developed for the UK population, and is intended for use in the UK. All medical decisions need to be taken by a patient in consultation with their doctor. The authors and the sponsors accept no responsibility for clinical use or misuse of this score.

The science underpinning QRISK®3 has been published in the BMJ -- see the publications tab for details.

### What is the difference between QRISK®3 and QRISK®2?

QRISK®3 includes more factors than QRISK®2 to help enable doctors to identify those at most risk of heart disease and stroke.
These are

- Chronic kidney disease, which now includes stage 3 CKD
- Migraine
- Corticosteroids
- Systemic lupus erythematosus (SLE)
- atypical antipsychotics
- severe mental illness
- erectile dysfunction
- a measure of systolic blood pressure variability

About you

Age (25-84): 50

Sex: (•) Male ( ) Female

Ethnicity: White or not stated

UK postcode: leave blank if unknown

Postcode: EC1

Leave blank if unknown

Cholesterol/HDL ratio: 5.0

Systolic blood pressure (mmHg): 145

Standard deviation of at least two most recent systolic blood pressure readings (mmHg):

Clinical information

Smoking status: moderate smoker (1

Diabetes status: none

Angina or heart attack in a 1st degr

Chronic kidney disease (stage 3, 4

Atrial fibrillation? ☐

On blood pressure treatment? ☑

Do you have migraines? ☐

Rheumatoid arthritis? ☐

Systemic lupus erythematosus (SLE

Severe mental illness?
(this includes schizophrenia, bipolar disor
moderate/severe depression)

On atypical antipsychotic medicatio

Are you on regular steroid tablets?

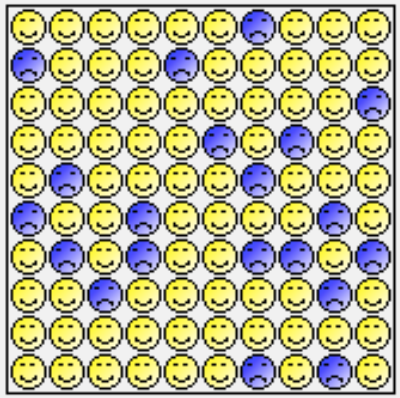
A diagnosis of or treatment for erect

## Your results

Your risk of having a heart attack or stroke within the next 10 years is:

**20.3%**

In other words, in a crowd of 100 people with the same risk factors as you, 20 are likely to have a heart attack or stroke within the next 10 years.



**Risk of**
**a heart attack or stroke**

Your score has been calculated using estimated data, as some information was left blank.

Your body mass index was calculated as 29.98 kg/m$^2$.

About you

Age (25-84): 50

Sex: (•) Male ( ) Female

Ethnicity: White or not stated

UK postcode: leave blank if unknown

Postcode: EC1

Clinical information

Smoking status: moderate smoker (1

Diabetes status: none

Angina or heart attack in a 1st degr

Chronic kidney disease (stage 3, 4

Atrial fibrillation? ☐

On blood pressure treatment? ☑

Do you have migraines? ☐

Rheumatoid arthritis? ☐

Systemic lupus erythematosus (SLE

Severe mental illness?
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On atypical antipsychotic medicatio

Are you on regular steroid tablets?

A diagnosis of or treatment for erect

Leave blank if unknown

Cholesterol/HDL ratio: 5.0

Systolic blood pressure (mmHg): 145

Standard deviation of at least two most recent systolic blood pressure readings (mmHg):

## Your results

Your risk of having a heart attack or stroke within the next 10 years is:

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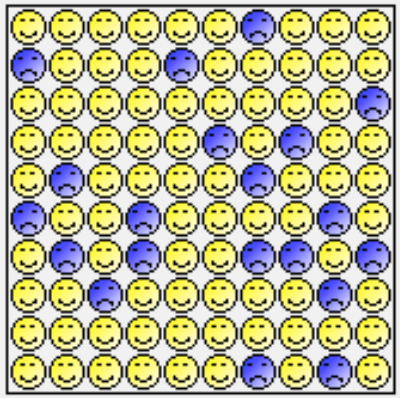
In other words, in a crowd of 100 people with the same risk factors as you, 20 are likely to have a heart attack or stroke within the next 10 years.



**Risk of**
**a heart attack or stroke**

Your score has been calculated using estimated data, as some information was left blank.

Your body mass index was calculated as 29.98 kg/m$^2$.

About you

Age (25-84): 50

Sex: Male Female

Ethnicity: White or not stated

UK postcode: leave bla

Postcode: EC1

Clinical information

Smoking status: modera

Diabetes status: none

Angina or heart attack in

Chronic kidney disease (

Atrial fibrillation?

On blood pressure treatm

Do you have migraines?

Rheumatoid arthritis?

Systemic lupus erythema

Severe mental illness?
(this includes schizophrenia, moderate/severe depression)

On atypical antipsychotic

Are you on regular steroi

A diagnosis of or treatme

Leave blank if unknown

Cholesterol/HDL ratio: 5.0

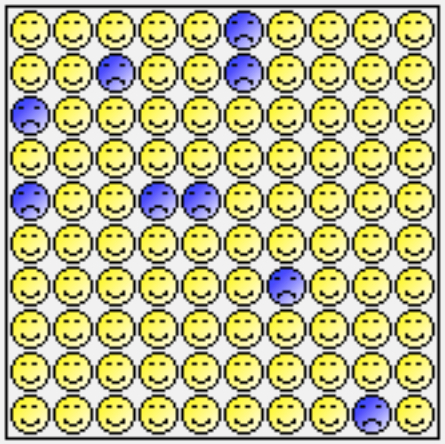
Systolic blood pressure (mmHg): 145

## Your results

Your risk of having a heart attack or stroke within the next 10 years is:

**8.5%**

In other words, in a crowd of 100 people with the same risk factors as you, 9 are likely to have a heart attack or stroke within the next 10 years.



**Risk of**
**a heart attack or stroke**

Your score has been calculated using estimated data, as some information was left blank.

Your body mass index was calculated as 26.83 kg/m$^2$.

# Hypertension in adults: diagnosis and treatment

NICE National Institute for Health and Care Excellence

**Offer lifestyle advice and continue to offer it periodically**

## Clinic BP

**Under 140/90 mmHg**

→ Check BP at least every 5 years and more often if close to 140/90 mmHg

**140/90 to 179/119 mmHg**

→
- Offer ABPM (or HBPM if ABPM is declined or not tolerated)
- Investigate for target organ damage
- Assess cardiovascular risk

**180/120 mmHg or more**

→
- Assess for target organ damage as soon as possible:
  - Consider starting drug treatment immediately without ABPM/HBPM if target organ damage
  - Repeat clinic BP in 7 days if no target organ damage

→ **Refer for same-day specialist review if:**
- retinal haemorrhage or papilloedema (accelerated hypertension) or
- life-threatening symptoms or
- suspected pheochromocytoma

## ABPM or HBPM

**Use clinical judgement for people with frailty or multimorbidity**

**Under 135/85 mmHg**

→
- Check BP at least every 5 years and more often if clinic BP close to 140/90 mmHg
- If evidence of target organ damage, consider alternative causes

**135/85 to 149/94 mmHg (Stage 1)**

→ **Age >80 with clinic BP >150/90 mmHg:**
- Offer lifestyle advice and consider drug treatment

**Age <80 with target organ damage, CVD, renal disease, diabetes or 10-year CVD risk ≥10%:**
- Offer lifestyle advice and discuss starting drug treatment

**Age <60 with 10-year CVD risk <10%:**
- Offer lifestyle advice and consider drug treatment

**Age <40:**
- Consider specialist evaluation of secondary causes and assessment long-term benefits and risks of treatment

→ Discuss the person's CVD risk and preferences for treatment, including no treatment.

See NICE's patient decision aid for hypertension

See next page for choice of drug, monitoring and BP targets.
- Offer annual review
- Support adherence to treatment

**150/95 mmHg or more (Stage 2)**

→ Offer lifestyle advice and drug treatment

**Age <40:**
- Consider specialist evaluation of secondary causes and assessment long-term benefits and risks of treatment

→

Abbreviations: ABPM, ambulatory blood pressure monitoring; BP, blood pressure; CVD, cardiovascular disease; HBPM, home blood pressure monitoring.

This is a summary of the recommendations on diagnosis and treatment from NICE's guideline on hypertension in adults. See the original guidance at www.nice.org.uk/guidance/NG136

NHS
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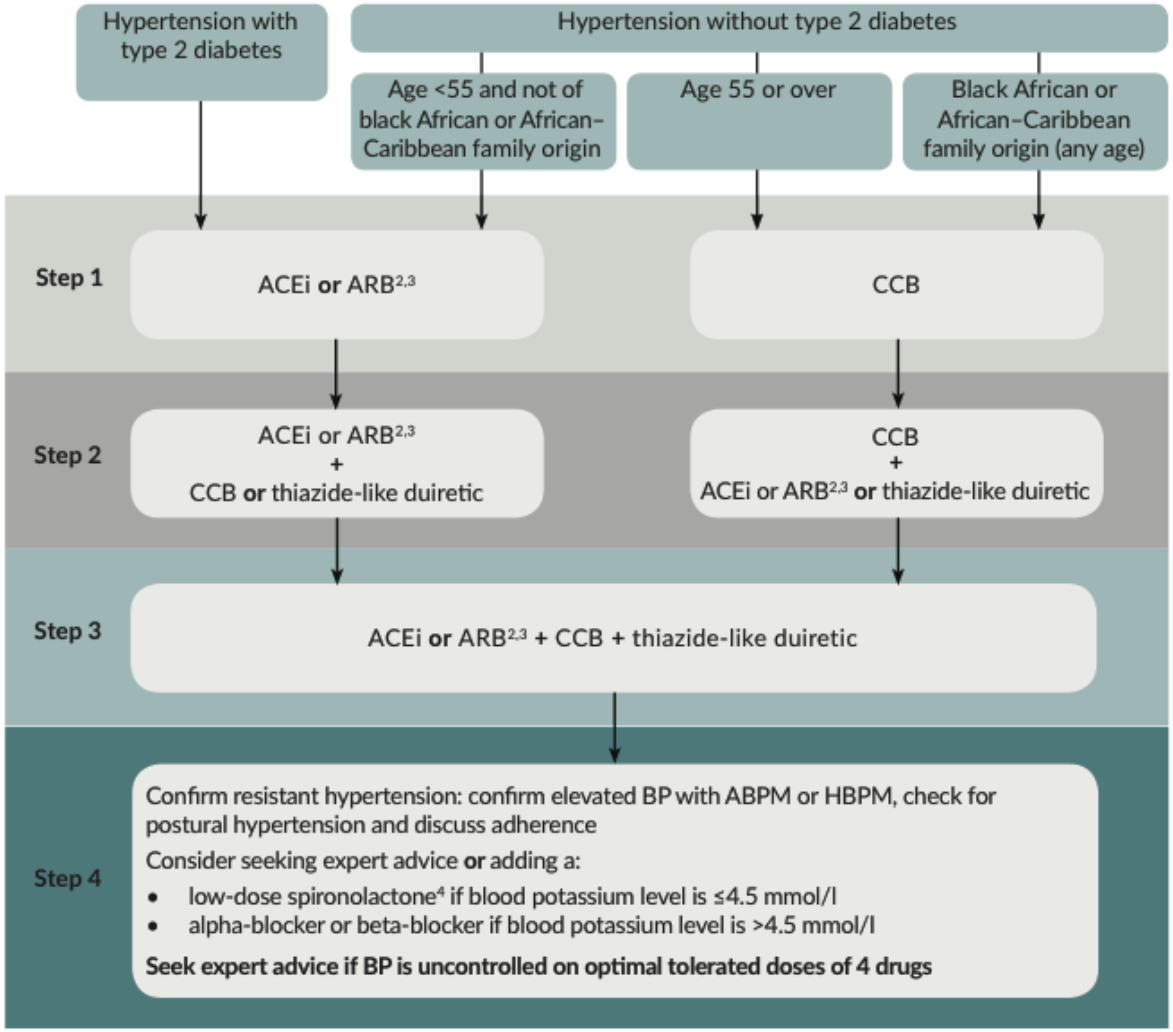
# Treatment the NICE way

# Choice of antihypertensive drug[1], monitoring treatment and BP targets




## Monitoring treatment

Use clinic BP to monitor treatment.

Measure standing and sitting BP in people with:

- type 2 diabetes **or**
- symptoms of postural hypotension **or**
- aged 80 and over.

Advise people who want to self-monitor to use HBPM. Provide training and advice.

Consider ABPM or HBPM, in addition to clinic BP, for people with white-coat effect or masked hypertension.

## BP targets

Reduce and maintain BP to the following targets:

**Age <80 years:**

- Clinic BP <140/90 mmHg
- ABPM/HBPM <135/85 mmHg

**Age ≥80 years:**

- Clinic BP <150/90 mmHg
- ABPM/HBPM <145/85 mmHg

**Postural hypotension:**

- Base target on standing BP

**Frailty or multimorbidity:**

- Use clinical judgement

[1] For women considering pregnancy or who are pregnant or breastfeeding, see NICE's guideline on hypertension in pregnancy. For people with chronic kidney disease, see NICE's guideline on chronic kidney disease. For people with heart failure, see NICE's guideline on chronic heart failure

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This visual summary builds on and updates previous work on treatment published by the BIHS (formerly BHS)

Abbreviations: ABPM, ambulatory blood pressure monitoring; ACEi, ACE inhibitor; ARB, angiotensin-II receptor blocker; BP, blood pressure; CCB, calcium-channel blocker; HBPM, home blood pressure monitoring.


Published: August 2019

# Office BP treatment target range

Barts Health NHS Trust

| Age group | Office SBP treatment target ranges (mmHg) | | | | | Office DBP treatment target range (mmHg) |
|---|---|---|---|---|---|---|
| | Hypertension | + Diabetes | + CKD | + CAD | + Stroke/TIA | |
| 18–65 years | **Target to 130** *or lower if tolerated* Not < 120 | **Target to 130** *or lower if tolerated* Not < 120 | **Target to 130** *or lower if tolerated* Not < 120 | **Target to 130** *or lower if tolerated* Not < 120 | **Target to 130** *or lower if tolerated* Not < 120 | 70-79 |
| 65–79 years | **Target to < 140 to 130** *if tolerated* | **Target to < 140 to 130** *if tolerated* | **Target to < 140 to 130** *if tolerated* | **Target to < 140 to 130** *if tolerated* | **Target to < 140 to 130** *if tolerated* | 70-79 |
| ≥ 80 years | **Target to < 140 to 130** *if tolerated* | **Target to < 140 to 130** *if tolerated* | **Target to < 140 to 130** *if tolerated* | **Target to < 140 to 130** *if tolerated* | **Target to < 140 to 130** *if tolerated* | 70-79 |
| **Office DBP treatment target range(mmHg)** | 70-79 | 70-79 | 70-79 | 70-79 | 70-79 | |

Williams, Mancia et al., J Hypertens 2018;36:1953-2041 and Eur Heart J 2018;39:3021-3104

ESC European Society of Cardiology

European Society of Hypertension

ORIGINAL ARTICLE

NHS
rts Health
NHS Trust

# A Randomized Trial of Intensive versus Standard Blood-Pressure Control

The SPRINT Research Group*

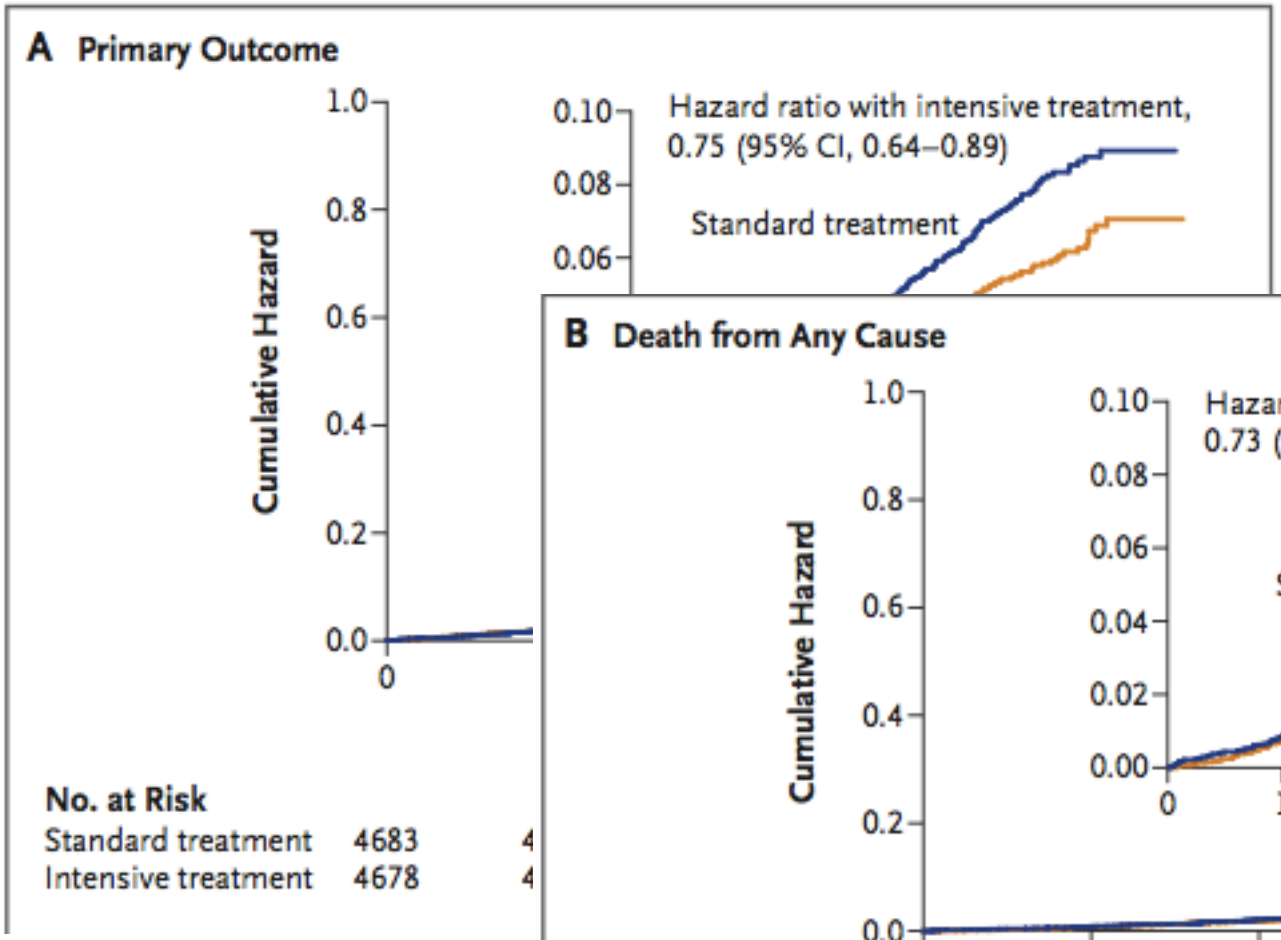
- RCT with 9361 pts with BP >130mmHg, increased CV risk with out diabetes
- Randomise to BP target <120 vs <140mmHg
- No guide to use as such – open formulary!
- 1ry outcome composite of

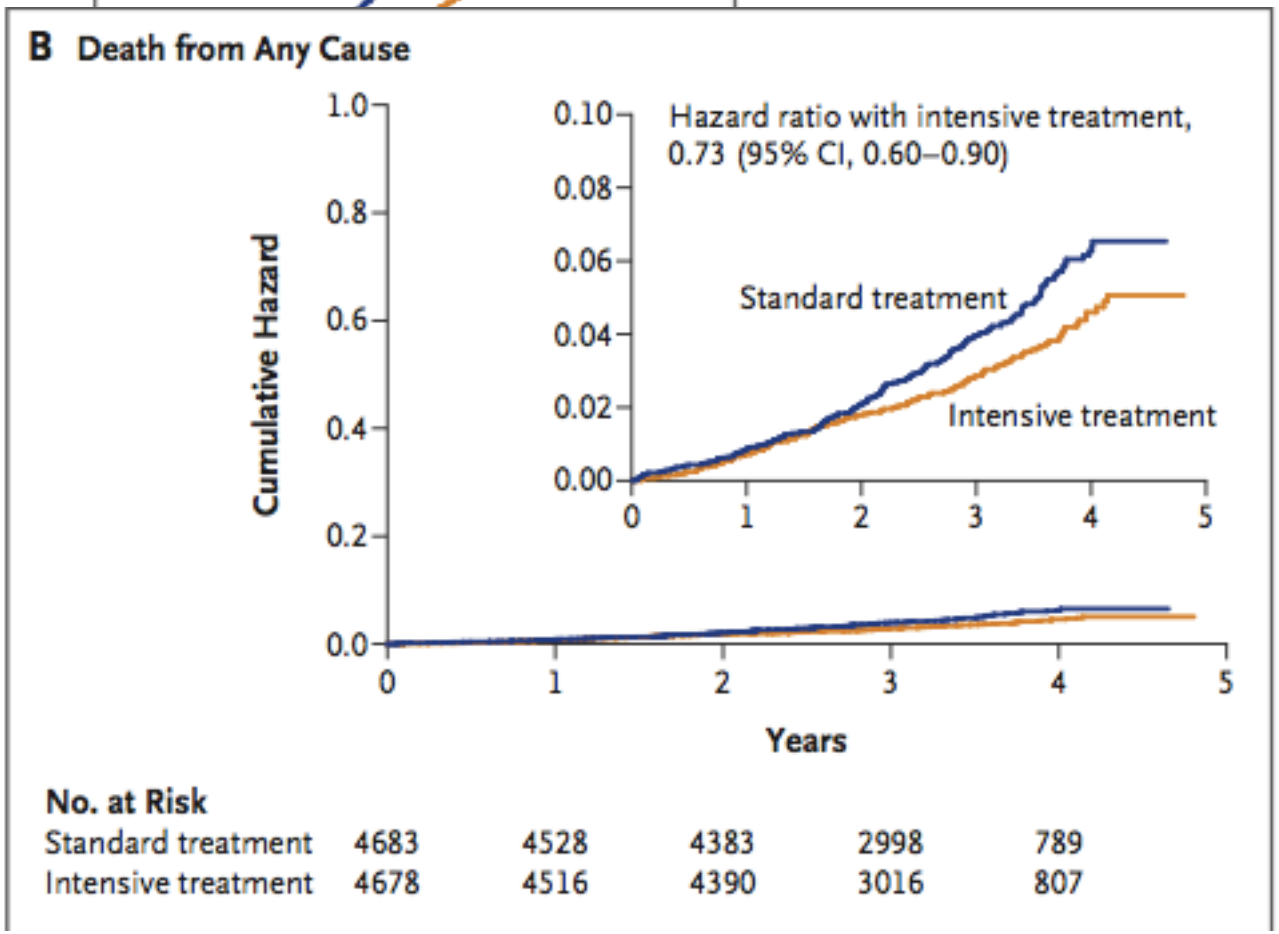
MI, ACS, stroke, HF or CV death

- Stopped after median 3.2yr

# SPRINT Results

Barts Health NHS Trust



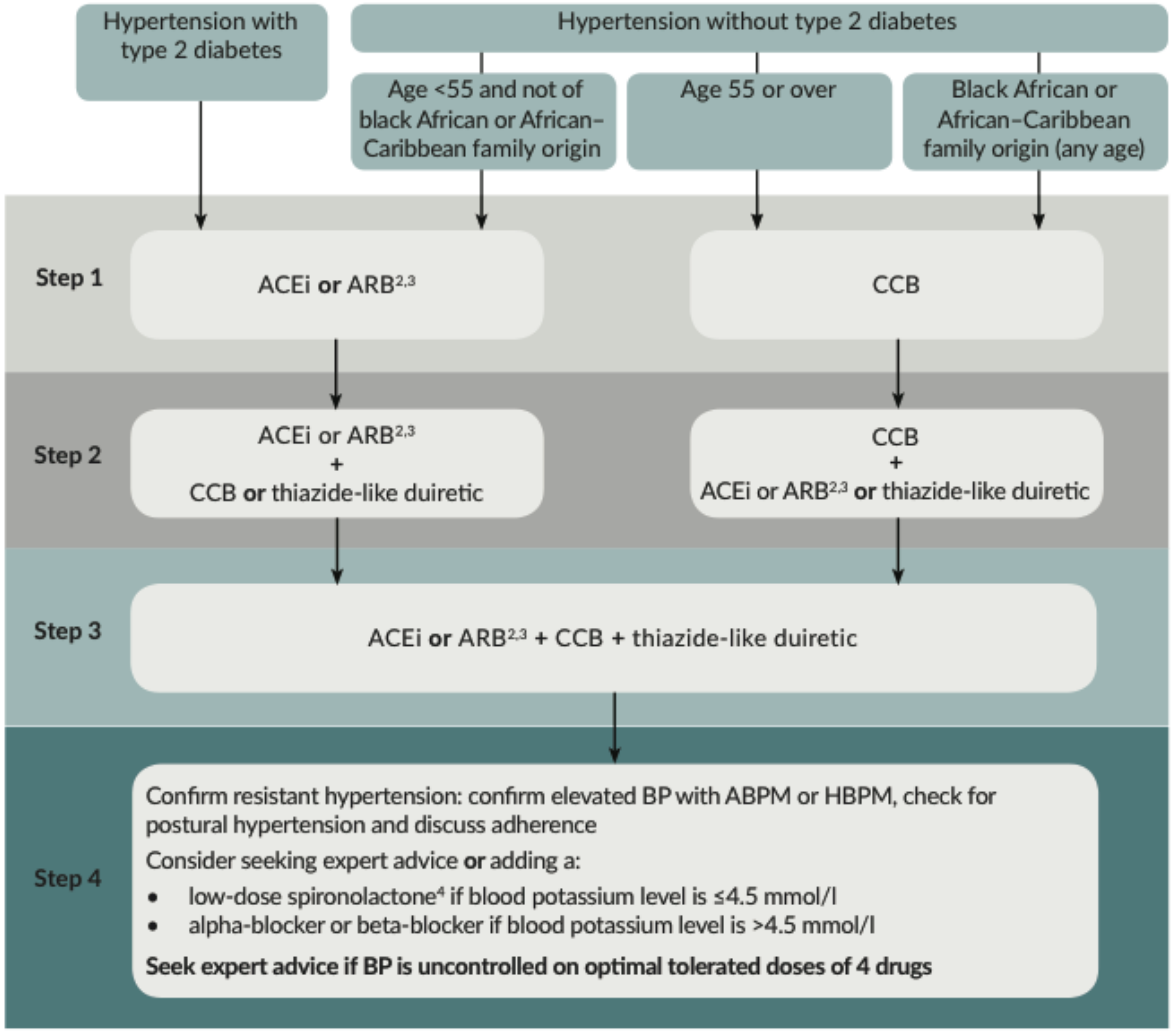
# SPRINT Results

NHS Barts Health

**Table 3. Serious Adverse Events, Conditions of Interest, and Monitored Clinical Events.**

| Variable | Intensive Treatment (N=4678) | Standard Treatment (N=4683) | Hazard Ratio | P Value |
|---|---|---|---|---|
| | *no. of patients (%)* | | | |
| Serious adverse event* | 1793 (38.3) | 1736 (37.1) | 1.04 | 0.25 |
| Conditions of interest | | | | |
| Serious adverse event only | | | | |
| Hypotension | 110 (2.4) | 66 (1.4) | 1.67 | 0.001 |
| Syncope | 107 (2.3) | 80 (1.7) | 1.33 | 0.05 |
| Bradycardia | 87 (1.9) | 73 (1.6) | 1.19 | 0.28 |
| Electrolyte abnormality | 144 (3.1) | 107 (2.3) | 1.35 | 0.02 |
| Injurious fall† | 105 (2.2) | 110 (2.3) | 0.95 | 0.71 |
| Acute kidney injury or acute renal failure‡ | 193 (4.1) | 117 (2.5) | 1.66 | <0.001 |
| Emergency department visit or serious adverse event | | | | |
| Hypotension | 158 (3.4) | 93 (2.0) | 1.70 | <0.001 |
| Syncope | 163 (3.5) | 113 (2.4) | 1.44 | 0.003 |
| Bradycardia | 104 (2.2) | 83 (1.8) | 1.25 | 0.13 |
| Electrolyte abnormality | 177 (3.8) | 129 (2.8) | 1.38 | 0.006 |
| Injurious fall† | 334 (7.1) | 332 (7.1) | 1.00 | 0.97 |
| Acute kidney injury or acute renal failure‡ | 204 (4.4) | 120 (2.6) | 1.71 | <0.001 |

# Choice of antihypertensive drug[1], monitoring treatment and BP targets

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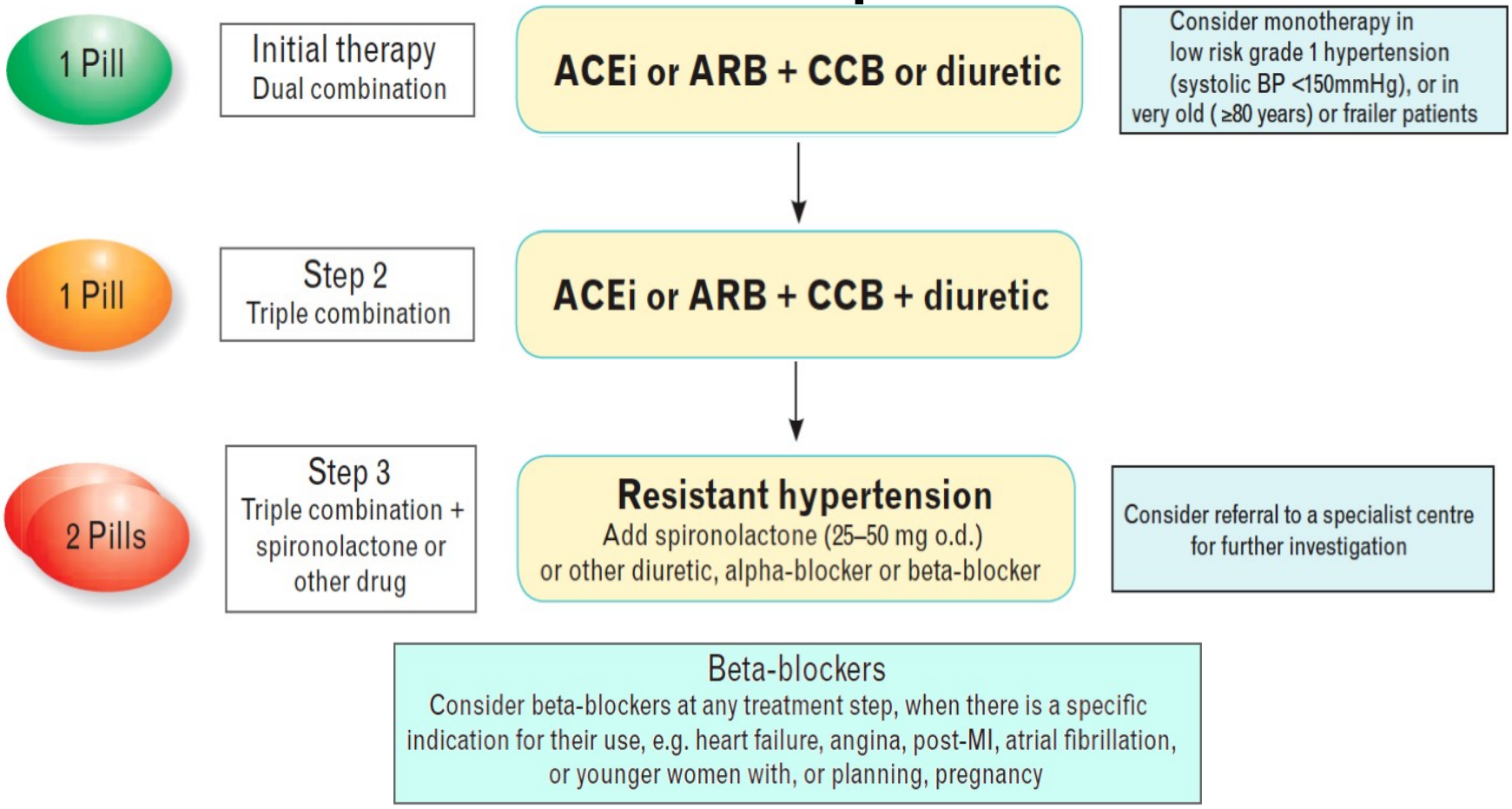
Published: August 2019

# Core drug-treatment strategy for uncomplicated






*The core algorithm is also appropriate for most patients with HMOD, cerebrovascular disease, diabetes, or PAD*



Williams, Mancia et al., J Hypertens 2018;36:1953-2041 and Eur Heart J 2018;39:3021-3104

# Compelling and possible contraindications to the use of specific antihypertensive drugs



| Drug | Contraindications | |
|---|---|---|
| | **Compelling** | **Possible** |
| Diuretics (thiazides/thiazide-type, e.g. chlorthalidone and indapamide) | • Gout | • Metabolic syndrome<br>• Glucose intolerance<br>• Pregnancy<br>• Hypercalcemia<br>• Hypokalemia |
| Beta-blockers | • Asthma<br>• Any high-grade sino-atrial or atrioventricular block<br>• Bradycardia (heart rate < 60 beats per min) | • Metabolic syndrome<br>• Glucose intolerance<br>• Athletes and physically active patients |
| Calcium antagonists (dihydropyridines) | | • Tachyarrhythmia<br>• Heart failure (HFrEF, class III or IV)<br>• Pre-existing severe leg oedema |
| Calcium antagonists (verapamil, diltiazem) | • Any high-grade sino-atrial or AV block<br>• Severe LV dysfunction (LV EF < 40%)<br>• Bradycardia (heart rate < 60 beats per min) | • Constipation |
| ACE inhibitors | • Pregnancy<br>• Previous angioneurotic oedema<br>• Hyperkalemia (potassium > 5.5 mmol/L)<br>• Bilateral renal artery stenosis | • Women of child-bearing potential without reliable contraception |
| ARBs | • Pregnancy<br>• Hyperkalemia (potassium > 5.5 mmol/L)<br>• Bilateral renal artery stenosis | • Women of child-bearing potential without reliable contraception |



Williams, Mancia et al., J Hypertens 2018;36:1953-2041 and Eur Heart J 2018;39:3021-3104

# Medications and other substances that may increase BP

| Medication/substance | |
|---|---|
| Oral contraceptive pill | Especially oestrogen containing; cause hypertension in 5% of women, usually mild but can be severe |
| Diet pills | For example, phenylpropanolamine and sibutramine |
| Nasal decongestants | For example, phenylephrine hydrochloride and naphazoline hydrochloride |
| Stimulant drugs | Amphetamine, cocaine, and ecstasy – these substances usually cause acute rather than chronic hypertension |
| Liquorice | Chronic excessive liquorice use mimics hyperaldosteronism by stimulating the mineralocorticoid receptor and inhibiting cortisol metabolism |
| Immunosuppressive medications | For example, cyclosporin A (tacrolimus has less effect on BP and rapamycin has almost no effect on BP), and steroids (e.g. corticosteroids, hydrocortisone) |
| Antiangiogenic cancer therapies | Antiangiogenic drugs, such as VEGF inhibitors (e.g. bevacizumab), tyrosine kinase inhibitors (e.g. sunitinib), and sorafenib, have been reported to increase BP |
| Other drugs and substances that may raise BP | Anabolic steroids, erythropoietin, non-steroidal anti-inflammatory drugs, herbal remedies (e.g. ephedra, ma huang) |



Williams, Mancia et al., J Hypertens 2018;36:1953-2041 and Eur Heart J 2018;39:3021-3104

# *Not to do* messages from the guidelines



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| | | |
|---|---|---|
| Withdrawal of BP-lowering drug treatment on the basis of age, even when patients attain an age of ≥ 80 years, is not recommended, provided that treatment is well tolerated. | III | A |
| The combination of two RAS blockers is not recommended. | III | A |
| Aspirin is not recommended for primary prevention in hypertensive patients without CVD. | III | A |
| Routine genetic testing for hypertensive patients is not recommended. | III | C |
| Use of device-based therapies is not recommended for the routine treatment of hypertension, unless in the context of clinical studies and RCTs, until further evidence regarding their safety and efficacy becomes available. | III | B |
| It is recommended to avoid binge drinking. | III | A |
| Routine drug treatment is not indicated for white coat hypertension. | III | C |

ESC European Society of Cardiology

Williams, Mancia et al., J Hypertens 2018;36:1953-2041 and Eur Heart J 2018;39:3021-3104

European Society of Hypertension

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# RESISTANT HYPERTENSION

# Resistant hypertension

Barts Health NHS Trust

Clinic blood pressure > 140 or > 90 mmHg with

the optimal or *best tolerated doses* of:

ACE inhibitor (or angiotensin-II receptor blocker) +
calcium channel blocker +
diuretic

NICE CG127, 2011; guidance.nice.org.uk/cg127

# Resistant hypertension

Barts Health NHS Trust

## The PATHWAY-2 study hypothesis:

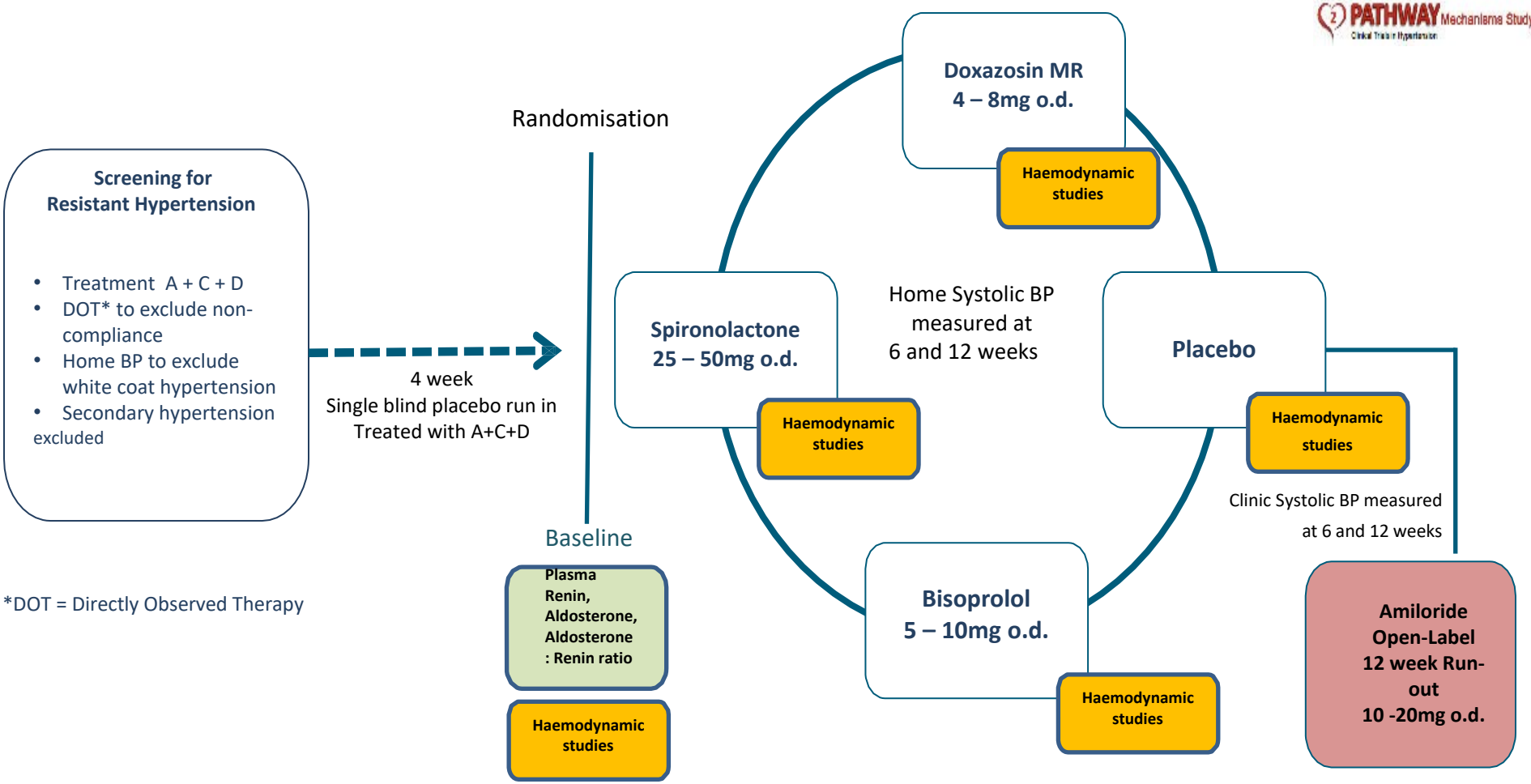
- That resistant hypertension is predominantly a sodium-retaining state

- That, further diuretic therapy with spironolactone would be the most effective additional treatment to lower blood pressure

- When added to therapy with at least 3 medications; ACE-inhibitor or ARB (A), a CCB (C) and a diuretic (D), i.e. A+C+D.

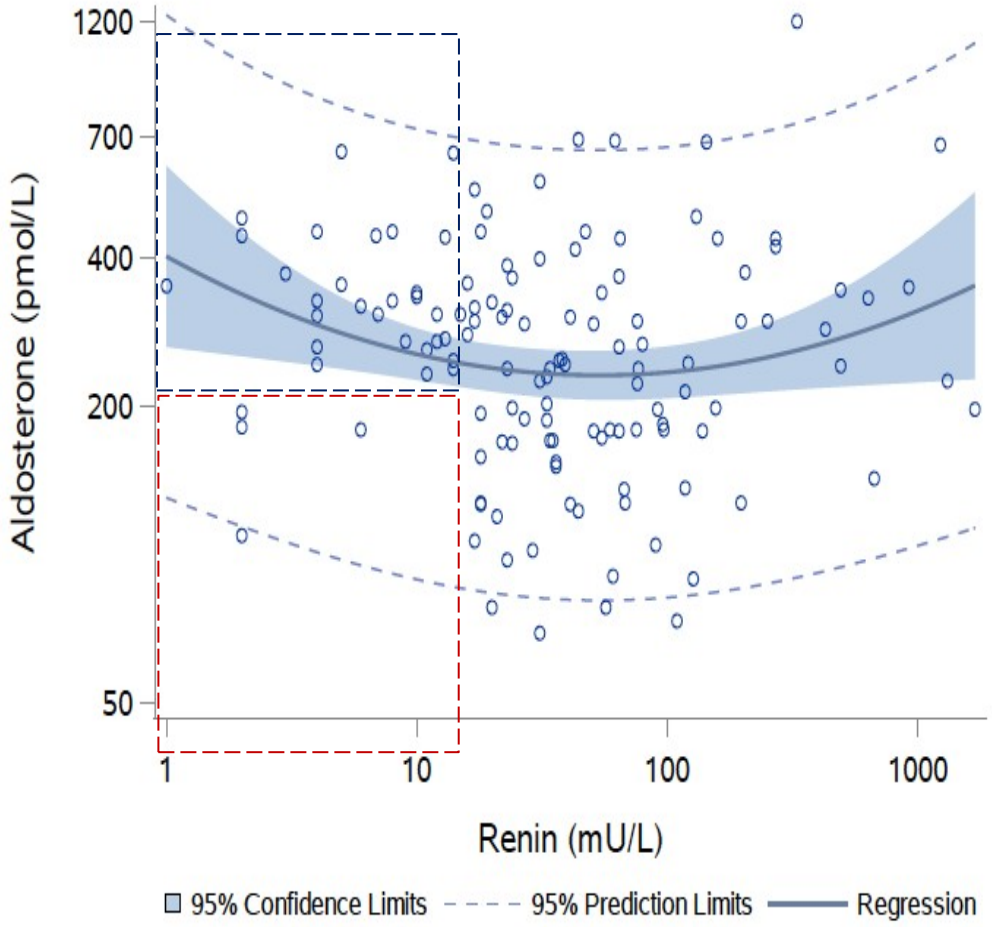
Williams B, et al. Lancet 2015

# PATHWAY-2 Mechanisms study




Williams B, et al. Lancet 2015

# Relationship between renin and aldosterone levels in resistant hypertension




p=0.340 for the linear term
p=0.0215 for the quadratic term*

Very few patients with low renin and low aldosterone

Many more patients with a relative increase in aldosterone despite a low renin

*Quadratic equation:
aldosterone=2.365-
0.0309*renin+0.0806*renin*renin

Williams B, et al. Lancet 2015

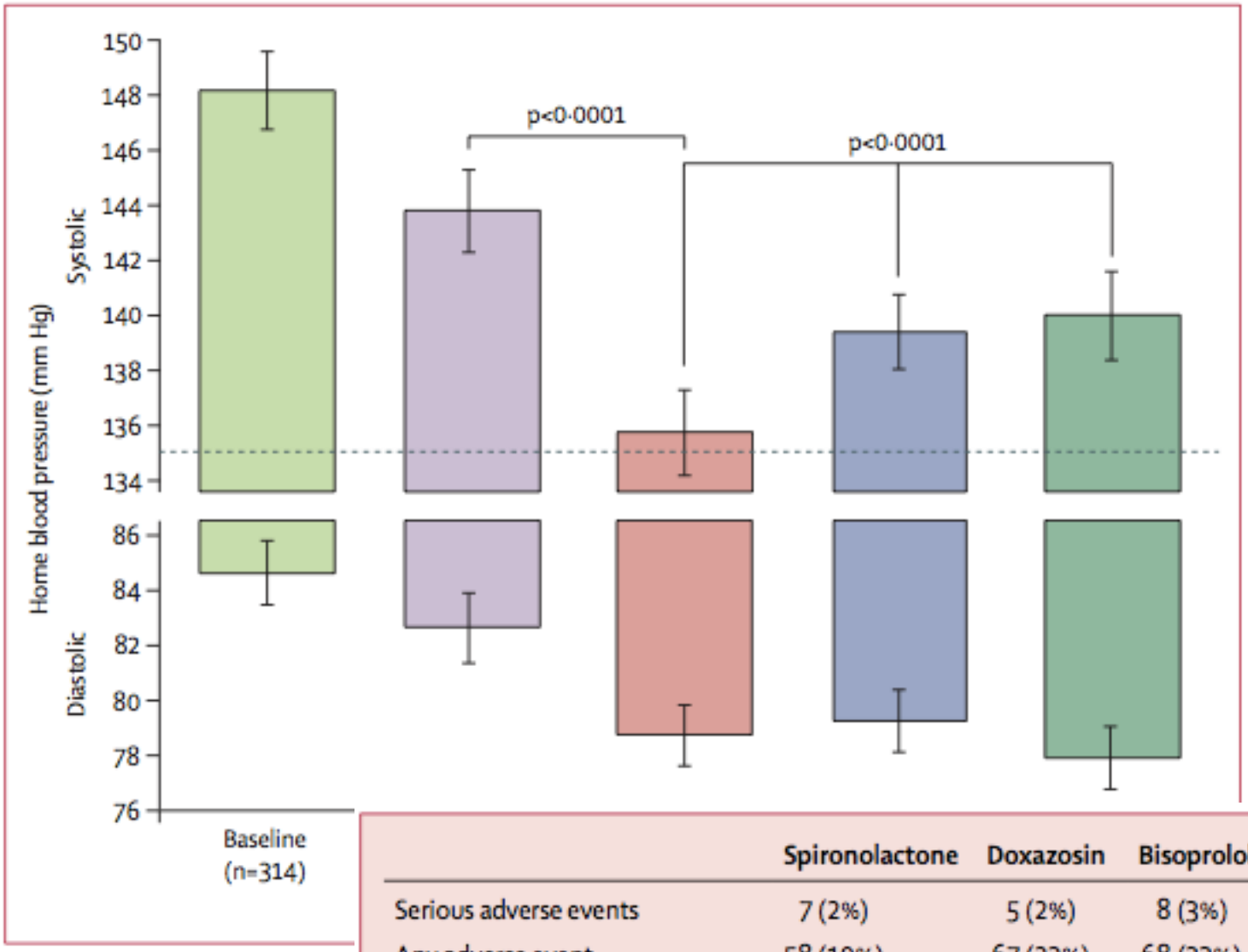



*Figure 2:* **Home systolic and dia other cycles**

| | Spironolactone | Doxazosin | Bisoprolol | Placebo | p value* |
|---|---|---|---|---|---|
| Serious adverse events | 7 (2%) | 5 (2%) | 8 (3%) | 5 (2%) | 0·82 |
| Any adverse event | 58 (19%) | 67 (23%) | 68 (23%) | 42 (15%) | 0·036 |
| Withdrawals for adverse events | 4 (1%) | 9 (3%) | 4 (1%) | 3 (1%) | 0·28 |

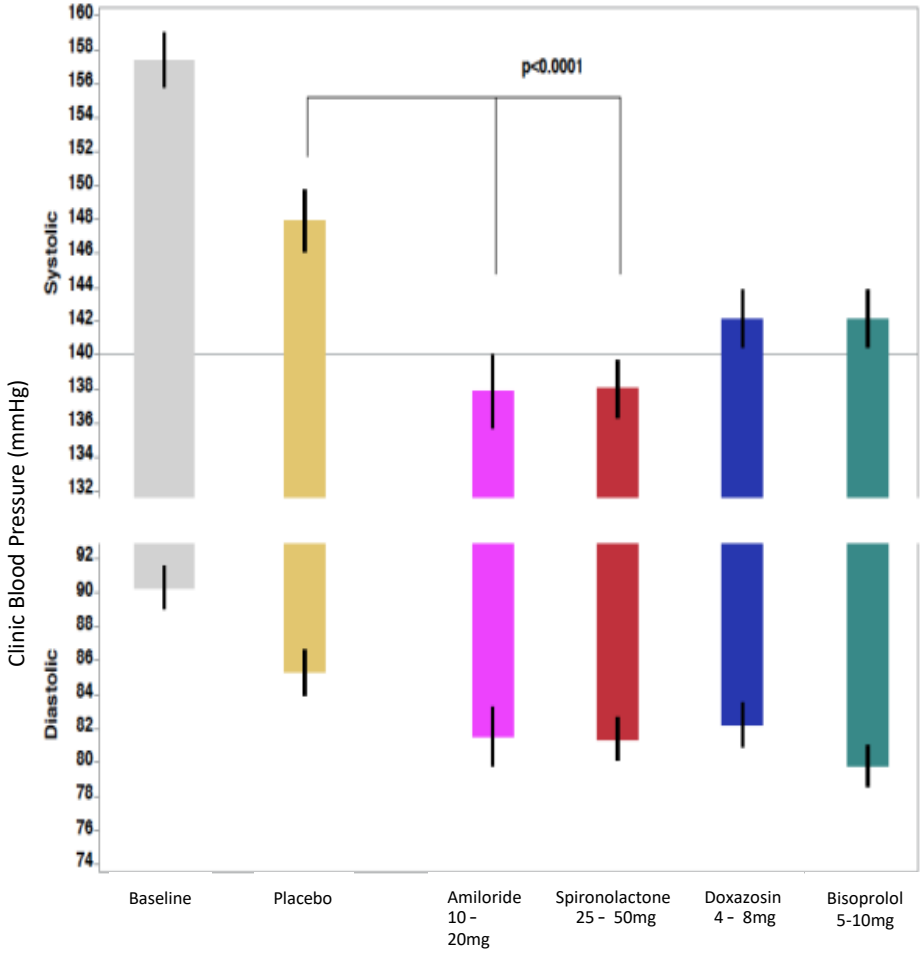
Data are n (%). *p values for Fisher's exact test. The most common adverse events in at least 5% of patients on any treatment are shown in appendix p 12.

*Table 5:* **Adverse events and withdrawals**

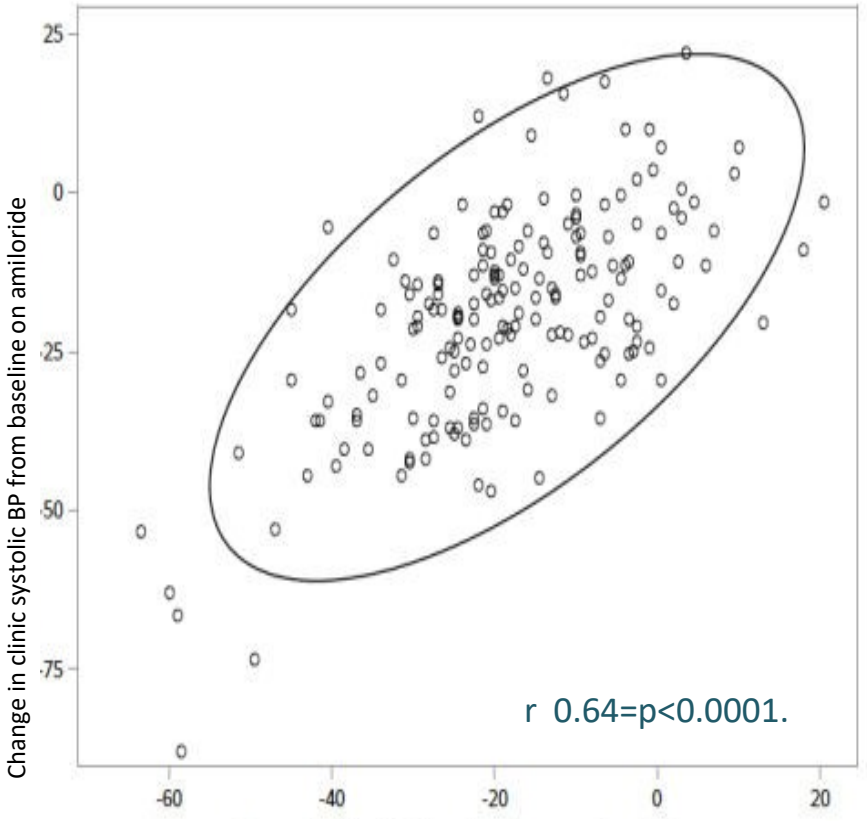
# Effects of amiloride versus spironolactone on clinic systolic BP in resistant hypertension

Barts Health NHS Trust

PATHWAY Mechanisms Study




Correlation of BP reduction with amiloride vs spironolactone




Williams B, et al. Lancet 2015

# Summary and Conclusions

PATHWAY Mechanisms Study
Clinical Trials in Hypertension

NHS
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- Resistant Hypertension is predominantly a sodium retaining state, characterised by low plasma renin, inappropriately elevated aldosterone, with the most effective treatment associated with a reduction in systemic volume, i.e. a diuretic
- Spironolactone (25-50mg daily) appears to act primarily as a diuretic to reduce blood pressure in resistant hypertension
- This effect is replicated by amiloride 10-20mg daily
- We speculate that a significant proportion of patients with resistant hypertension have inappropriate aldosterone excess due to aldosterone-producing microadenomas that are poorly detected by conventional imaging, explaining the quadratic relationship between aldosterone and renin levels and the superior response to anti-aldosterone diuretic therapy in these patients

Williams B, et al. Lancet 2015

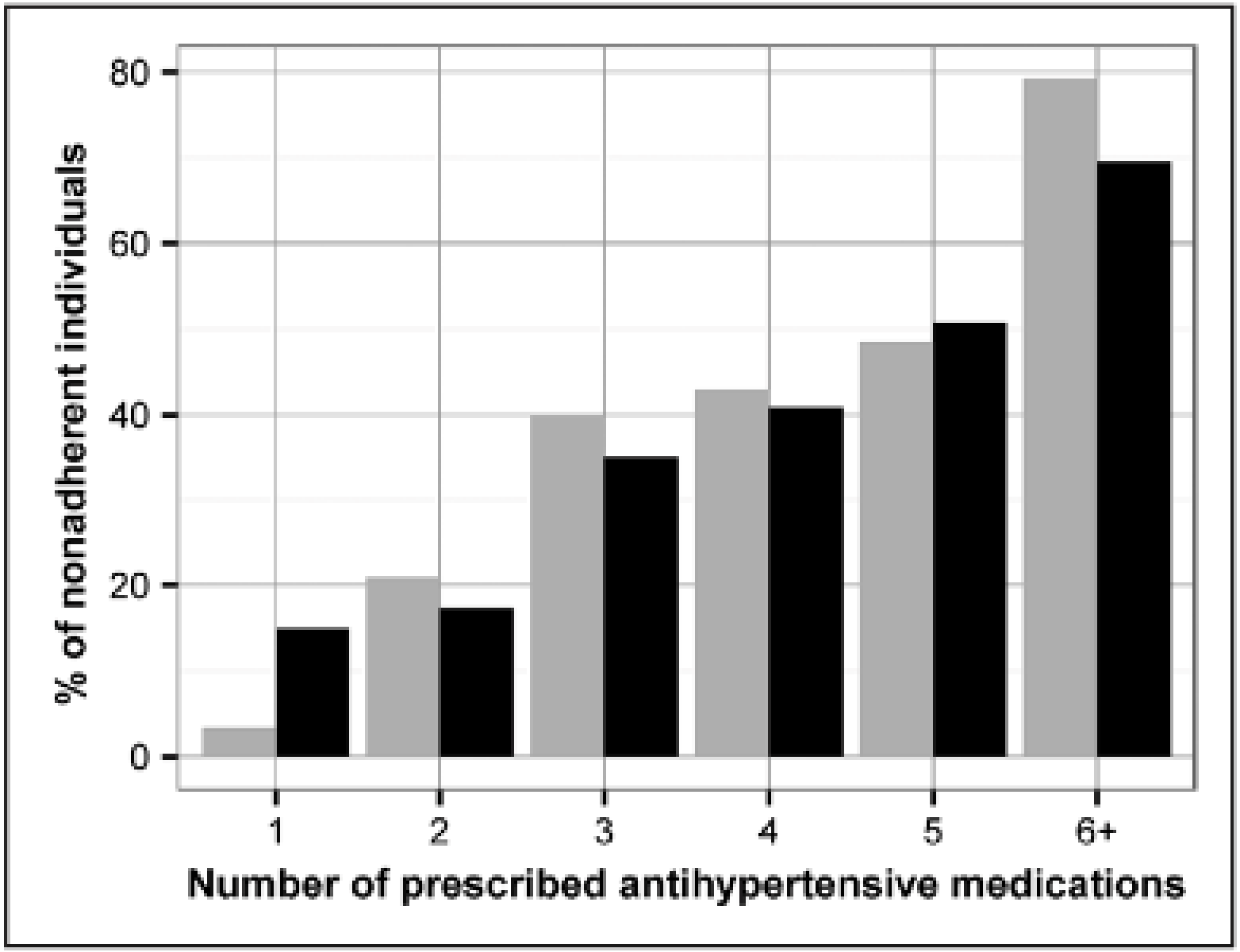
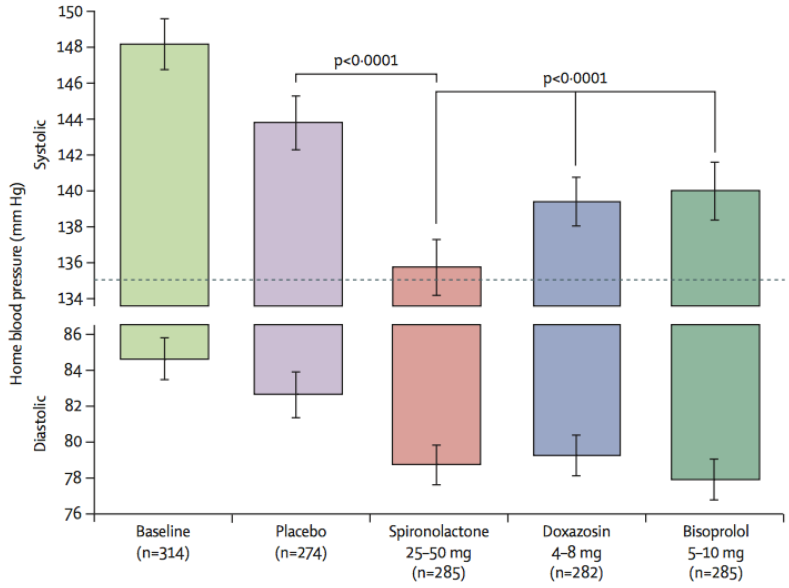



Figure. Association between the number of prescribed antihypertensive medications and the risk of nonadherence by population (gray, United Kingdom; black, Czech Republic).

***Hypertension*. 2017;69:1113-1120**

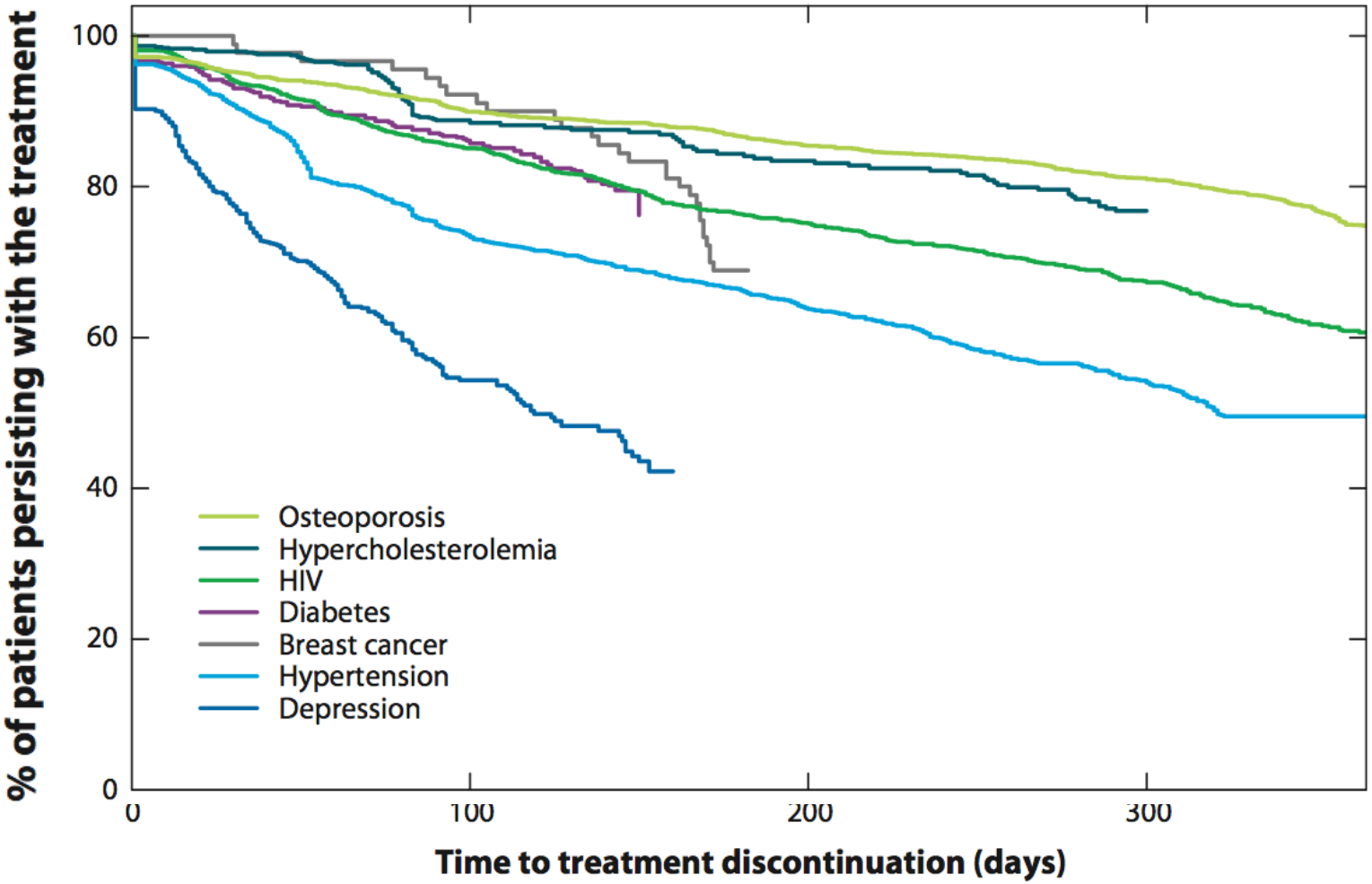
# Resistant hypertension: *medications work*




| | Blood pressure (mm Hg) | Change from baseline (mm Hg) |
|---|---|---|
| **Mean** | | |
| Spironolactone | 134·9 (134·0 to 135·9) | −12·8 (−13·8 to −11·8) |
| Doxazosin | 139·0 (138·0 to 140·0) | −8·7 (−9·7 to −7·7) |
| Bisoprolol | 139·4 (138·4 to 140·4) | −8·3 (−9·3 to −7·3) |
| Placebo | 143·6 (142·6 to 144·6) | −4·1 (−5·1 to −3·1) |
| **Mean differences** | | |
| Spironolactone vs placebo | 8·70 (−9·72 to −7·69) | p<0·0001 |
| Spironolactone vs mean bisoprolol and doxazosin | −4·26 (−5·13 to −3·38) | p<0·0001 |
| Spironolactone vs doxazosin | −4·03 (−5·04 to −3·02) | p<0·0001 |
| Spironolactone vs bisoprolol | −4·48 (−5·50 to −3·46) | p<0·0001 |

Williams B et al., *Lancet* 2015; 386: 2059-

# Poor adherence in HTN: epidemiology




Blaschke et al., Ann Rev Pharmacol Toxicol 2012; 52: 275-

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# Pharmacological strategies to lower BP:

# tips and tricks

# Barts BP stratified medicines approach

Barts Health NHS Trust

Can be based on 4 principles:

Antoniou et al., J Clin Hypertens 2016; 18: 129-138

# Management principles

Barts Health NHS Trust

Can be based on 4 principles:

1. Most ADRs to anti-hypertensive medications are dose dependent

Antoniou et al., J Clin Hypertens 2016; 18: 129-138

# Systematic review – drug related adverse events

Table 3. Safety Outcomes

| | Type of Antihypertensive Drug | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Calcium Channel Blocker | | | | | |
| | Diuretics | BB | ACE | Total | DHP | non-DHP | ARB | AAB | Placebo |
| % of patients with adverse events | 39.3 | 32.3 | 36.1 | 34.3 | 34.4 | 34.0 | 38.8 | 36.1 | 37.3 |
| No. analyzed | 694 | 2164 | 3869 | 4418 | 3865 | 553 | 1614 | 820 | 948 |
| % of discontinuations | 12.7 | 11.6 | 10.5 | 15.3 | 14.2 | 17.2 | 6.8 | 17.0 | 11.7 |
| No. analyzed | 1628 | 3759 | 5411 | 6441 | 4756 | 1409 | 2044 | 1103 | 1717 |
| % of DAEs | 3.1 | 4.5 | 4.7 | 6.7 | 6.9 | 5.7 | 3.1 | 6.0 | 4.3 |
| No. analyzed | 1799 | 4386 | 6531 | 9253 | 7485 | 1768 | 2994 | 1103 | 2132 |
| % of DAEs in studies ≤ 1 mo | NR | 3.2 | 1.8 | 3.0 | 2.9 | 3.8 | 3.3 | 5.6 | 1.9 |
| No. of pts with event | | 9 | 12 | 27 | 24 | 3 | 2 | 6 | 5 |
| No. analyzed | | 285 | 650 | 896 | 818 | 78 | 60 | 107 | 259 |
| % of DAEs in studies > 1 mo | 3.0 | 4.5 | 5.1 | 7.1 | 7.5 | 5.4 | 3.1 | 5.9 | 4.5 |
| No. of pts with event | 55 | 187 | 297 | 589 | 498 | 91 | 90 | 60 | 87 |
| No. analyzed | 1814 | 4143 | 5870 | 8354 | 6660 | 1694 | 2937 | 1013 | 1929 |
| DAEs risk difference[a] | 0.027 | 0.018 | 0.014 | -0.005 | NC | NC | 0.02 | NC | NC |
| 95% CI | (0.001, 0.053) | (-0.008, 0.044) | (-0.002, 0.029) | (-0.022, 0.012) | | | (0.001, 0.038) | | |
| p value | 0.038 | 0.171 | 0.085 | 0.577 | | | 0.038 | | |
| No. of studies | 5 | 6 | 17 | 14 | | | 7 | | |

BB = β-blocker; ACE = angiotensin-converting enzyme inhibitor; DHP = dihydropyridine; ARB = angiotensin receptor blocker; AAB = α-adrenergic blocker; No. analyzed = total number of patients evaluated for safety in each outcome category; NR = not reported; ; NC = not calculated.

[a]Results of random effects model in placebo comparisons.

Pharmacotherapy 2001;21(8):940–953

# Systematic review – drug related adverse events

Barts Health NHS Trust



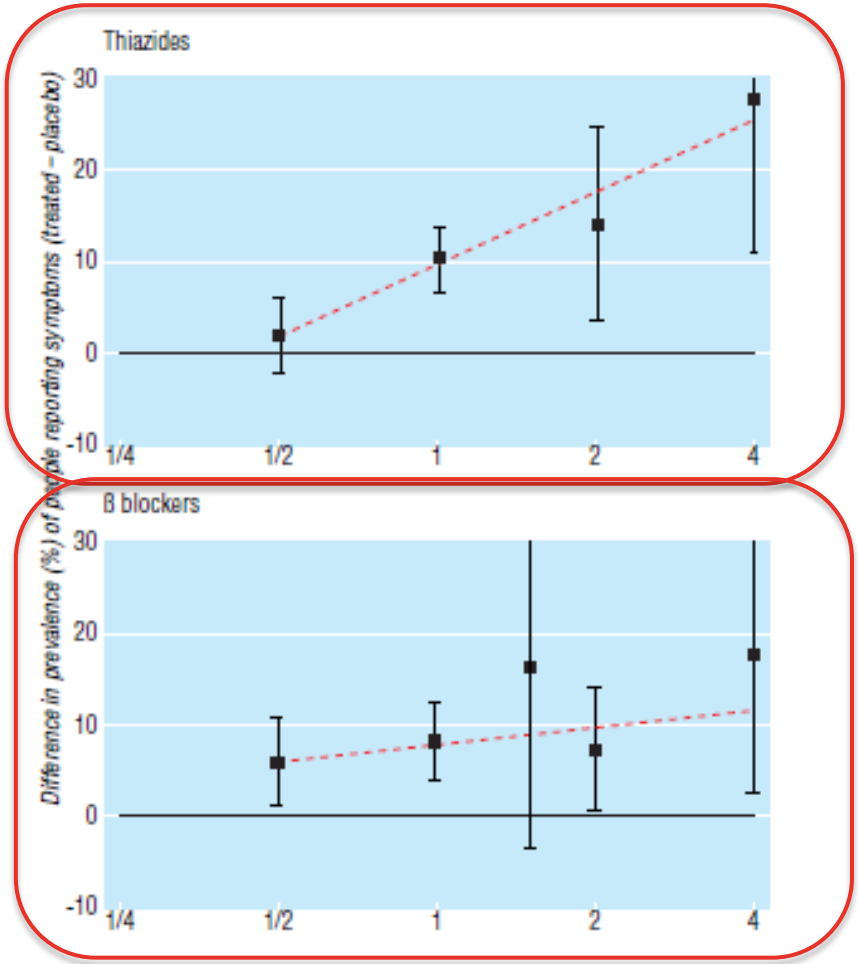
Table 2. Type of Antihypertensive Drug and Adverse Events by Organ System

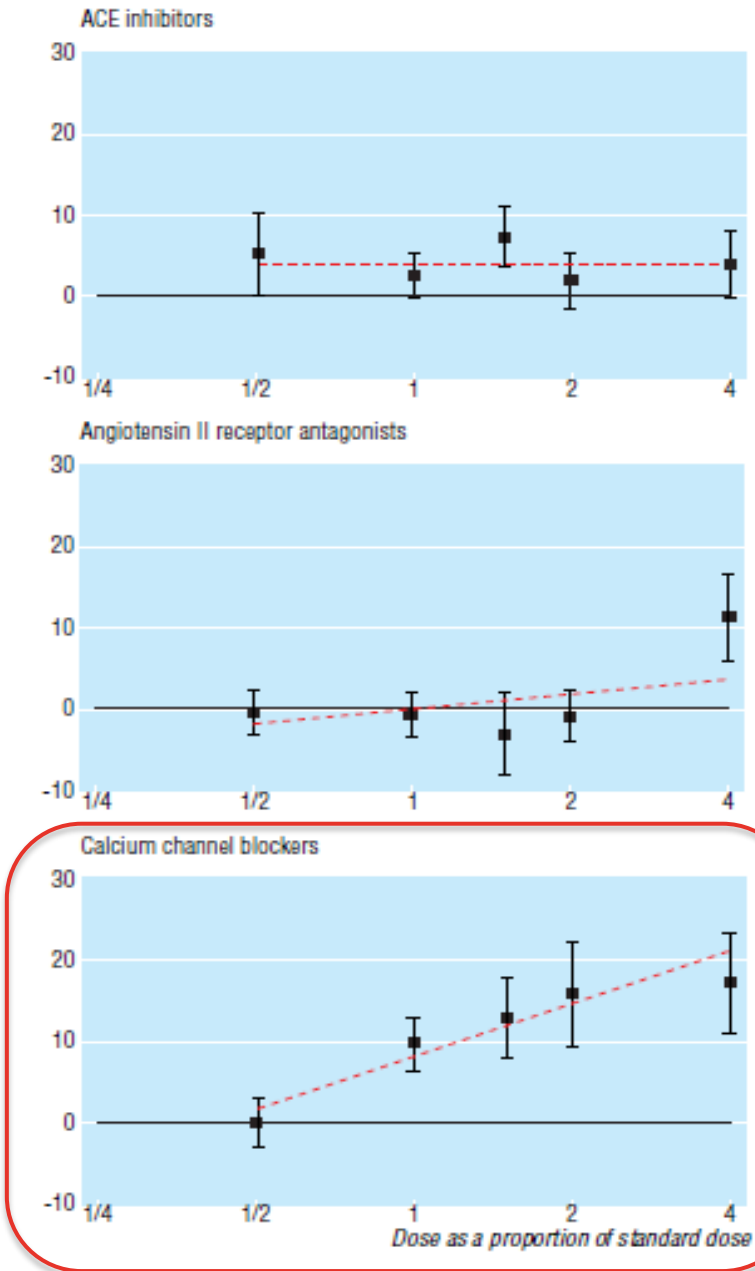
| | | No. of Patients Analyzed (% of patients with this event) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Organ System | Event | Diuretics | BB | ACE | CCB | ARB | AAB | Placebo |
| Whole body | Total AEs | 1081 (10.0) | 3349 (9.2) | 3938 (5.6) | 6883 (13.2) | 1438 (6.1) | 624 (7.1) | 1425 (6.8) |
| | Total DAEs | 702 (0.4) | 1746 (1.7) | 2268 (1.0) | 3775 (2.2) | 863 (0.2) | 114 (0.9) | 908 (0.6) |
| Respiratory | Total AEs | 978 (7.5) | 2519 (6.0) | 4683 (12.7) | 1764 (7.8) | 2182 (7.3) | 537 (4.7) | 1030 (5.7) |
| | Total DAEs | 353 (0.3) | 761 (0.4) | 3181 (2.0) | 1038 (0) | 1003 (0.2) | 85 (1.2) | 537 (0.4) |
| Cardiovascular | Total AEs | 867 (1.3) | 2486 (4.1) | 2411 (4.1) | 5347 (11.9) | 660 (1.2) | 476 (10.5) | 1058 (3.2) |
| | Total DAEs | 413 (1.0) | 994 (0.8) | 1721 (8.5) | 2723 (1.3) | 298 (0.7) | 99 (6.1) | 593 (1.2) |
| Dermatologic | Total AEs | 234 (3.8) | 1017 (4.1) | 2108 (3.5) | 1583 (6.8) | 236 (0.4) | 252 (1.2) | 189 (2.6) |
| | Total DAEs | 49 (2.0) | 669 (0.6) | 1196 (0.5) | 990 (0.8) | 616 (0.3) | NR | 220 (0.5) |
| Metabolic | Total AEs | 286 (12.6) | 264 (0) | 862 (3.2) | 230 (0.9) | 212 (11.8) | 47 (8.5) | 287 (2.4) |
| | Total DAEs | 295 (0.3) | 43 (0) | 397 (0.5) | 265 (0.4) | 212 (0) | NR | 242 (0.8) |
| Neurologic | Total AEs | 1106 (16.9) | 2991 (11.0) | 4092 (10.7) | 6502 (17.6) | 1888 (9.9) | 839 (19.9) | 1701 (11.8) |
| | Total DAEs | 512 (1.8) | 1175 (1.3) | 2653 (1.5) | 3645 (2.3) | 1252 (0.8) | 89 (1.1) | 1230 (1.5) |
| Psychiatric | Total AEs | 296 (3.7) | 2125 (4.9) | 1342 (4.7) | 1437 (3.4) | 257 (1.6) | 159 (6.9) | 346 (3.5) |
| | Total DAEs | 352 (0.3) | 832 (4.3) | 1050 (3.0) | 884 (0.7) | 212 (0.5) | 47 (0) | 231 (0.4) |
| Gastrointestinal | Total AEs | 828 (5.6) | 2068 (8.9) | 2509 (5.1) | 4337 (5.9) | 1476 (4.1) | 500 (6.4) | 862 (5.0) |
| | Total DAEs | 511 (1.6) | 1177 (0.6) | 2184 (1.1) | 1915 (0.6) | 539 (0.6) | 69 (1.4) | 318 (0.3) |

BB = β-blocker; ACE = angiotensin-converting enzyme inhibitor; CCB = calcium channel blocker; ARB = angiotensin receptor blocker; AAB = α-adrenergic blocker; NR = not reported.

Pharmacotherapy 2001;21(8):940–953

# Proportion of People reporting one or more symptoms attributable to treatment according to Drug class and Dose as a proportion of standard




Law et al. BMJ 2003;326:1427

# Management principles

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Can be based on 4 principles:

1. Most ADRs to anti-hypertensive medications are dose dependent therefore

   **fractional dosing** below the smallest whole pill weight [and not titrating] may allow patients to tolerate classes previously intolerant of

Antoniou et al., J Clin Hypertens 2016; 18: 129-138

# Management principles

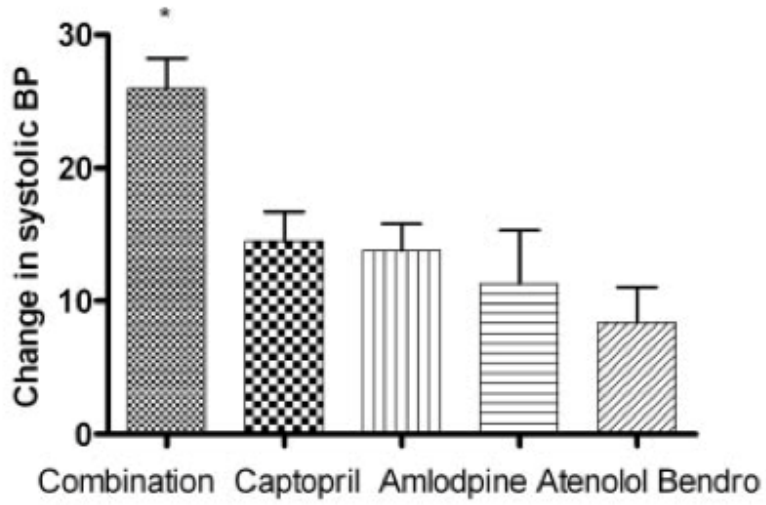
Barts Health NHS Trust

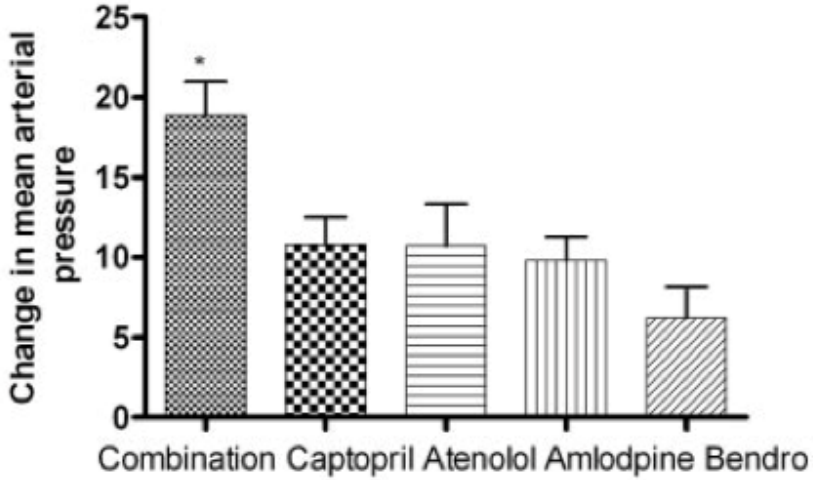
Can be based on 4 principles:

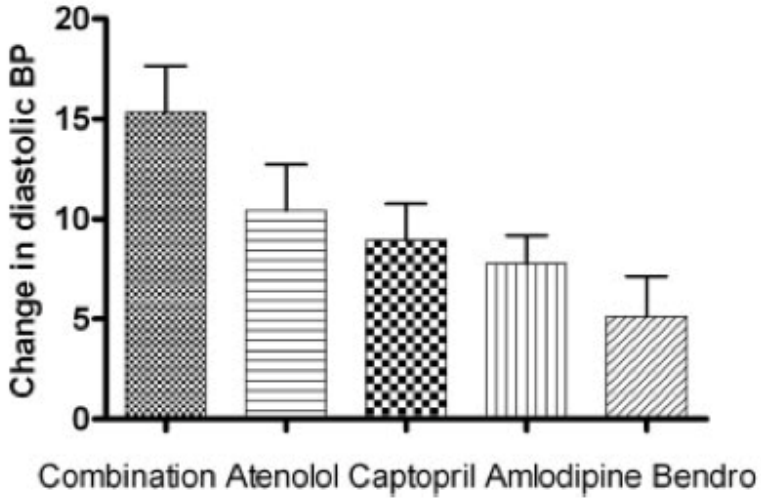
2. Combination of anti-hypertensive medications at low dose is more efficacious than increasing individual medication dose

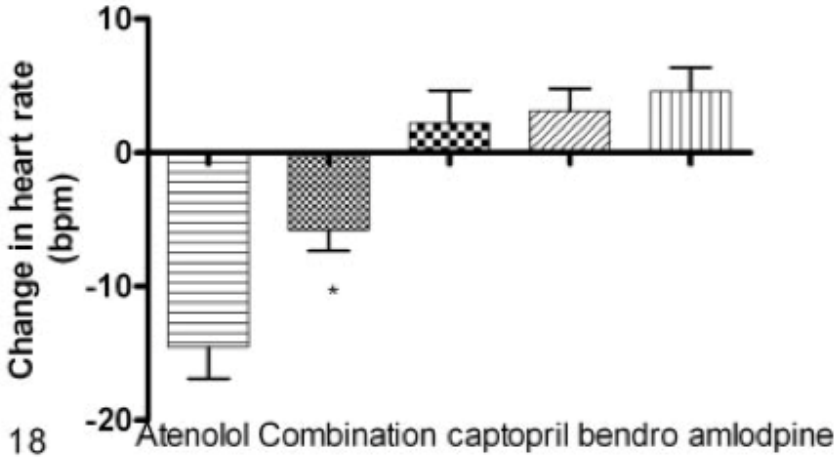
Antoniou et al., J Clin Hypertens 2016; 18: 129-138

# Low-dose combination



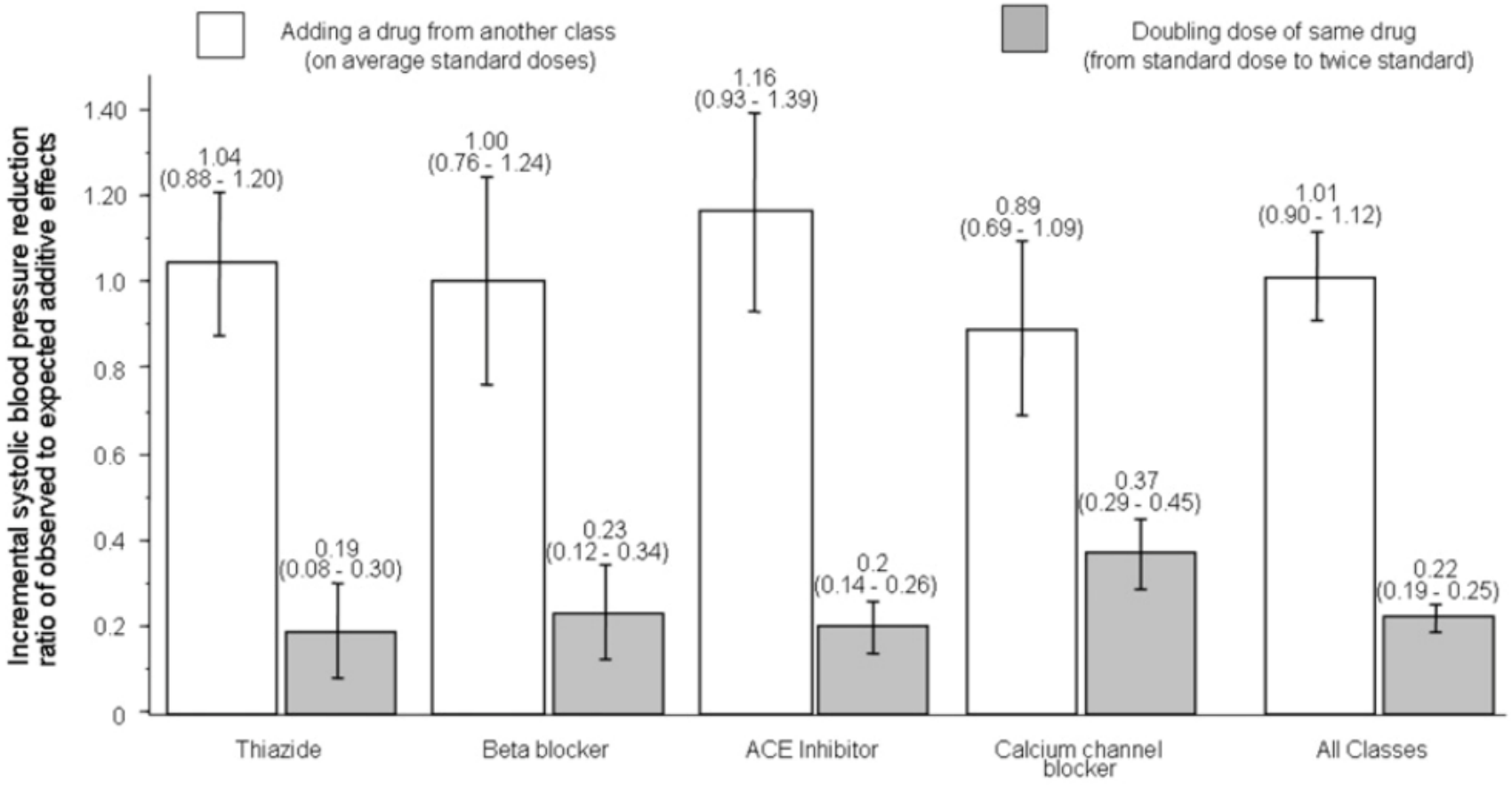






Mahmud & Feely, Hypertension 2005; 49: 272-

# Low-dose combination

Barts Health NHS Trust




Wald et al., Am J Med 2009; 122: 290-

# Management principles

Barts Health NHS Trust

Can be based on 4 principles:

2. Combination of anti-hypertensive medications at low dose is more efficacious than increasing individual medication dose therefore

**combine medications** at fractional doses including **ultra low doses via liquid formulations** [and not titrating to standard doses] may allow patients greater hypotensive efficacy without increasing ADR likelihood

Antoniou et al., J Clin Hypertens 2016; 18: 129-138

# Management principles

Barts Health NHS Trust

Can be based on 4 principles:

3. Some patients may not be able to tolerate excipients in solid dosage formulations

Antoniou et al., J Clin Hypertens 2016; 18: 129-138

# Excipients

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| Excipient | Frequency | Adverse effects |
|---|---|---|
| Sucrose | 25% | DM; problematic in fructose intolerance |
| Saccharin | 24% | urticaria; photosensitivity |
| Lactose | 23% | stomach cramps; bloating & flatulence; diarrhoea; muscle cramps; headaches |
| Silica | 23% | sarcoidosis |
| Parabens | 16% | contact dermatitis |
| Sorbitol | 10% | laxative |
| Aspartame | 9% | problematic in PKU |
| Ethanol | 7% | classical alcohol intoxication |
| Propylene glycol | 7% | cardio-renal failure |
| Mannitol | 6% | laxative |
| Menthol | 6% | laryngospasm; GI disturbance |

Ursino et al., Regul Toxicol Pharmacol 2011; 60: 93-

# Liquid formulations


- Avoiding tablet excipients
- community pharmacies
- £ liquids> generics


Retail Price List

Rosemont

| Products | Storage Instructions | Shelf Life | Pack Size |
|---|---|---|---|
| Aciclovir Oral Suspension 200mg/5ml (S/F) | Do not store above 25°C | 24 months / 1 month | 125ml |
| Aciclovir Oral Suspension 400mg/5ml (S/F) | Do not store above 25°C | 24 months / 1 month | 100ml |
| Alendronic Acid Oral Solution 70mg/100ml (S/F) | Do not store above 25°C | 24 months / Immediate use | 4 x 100ml |
| Amiloride Hydrochloride Oral Solution 5mg/5ml (S/F) | Do not store above 25°C | 18 months / 28 days | 150ml |
| Amitriptyline Hydrochloride Oral Solution 25mg/5ml (S/F) | Do not store above 25°C | 24 months / 6 months | 150ml |
| Amitriptyline Hydrochloride Oral Solution 50mg/5ml (S/F) | Do not store above 25°C | 24 months / 6 months | 150ml |
| Amlodipine Oral Solution 1mg/ml (S/F) | Store in a refrigerator (2 - 8°C) Keep the bottle stored upright | 12 months / 28 days | 150ml |
| Amlodipine Oral Solution 2mg/ml (S/F) | Store in a refrigerator (2 - 8°C) Keep the bottle stored upright | 12 months / 28 days | 150ml |
| Chlorpromazine Hydrochloride Oral Syrup | Do not store above 25°C | 24 months / 6 months | 150ml |
| | | | 150ml |

To plac

# Management principles

Barts Health NHS Trust

Can be based on 4 principles:

3. Some patients may not be able to tolerate excipients in solid dosage formulations

**liquid/transdermal formulations** may avoid these issues

Antoniou et al., J Clin Hypertens 2016; 18: 129-138

# Management principles

Barts Health NHS Trust

Can be based on 4 principles:

4. Patients may be reluctant to be rechallenged with previously tried medications or have persistent intolerance

Antoniou et al., J Clin Hypertens 2016; 18: 129-138

# Management principles

Barts Health NHS Trust

Can be based on 4 principles:

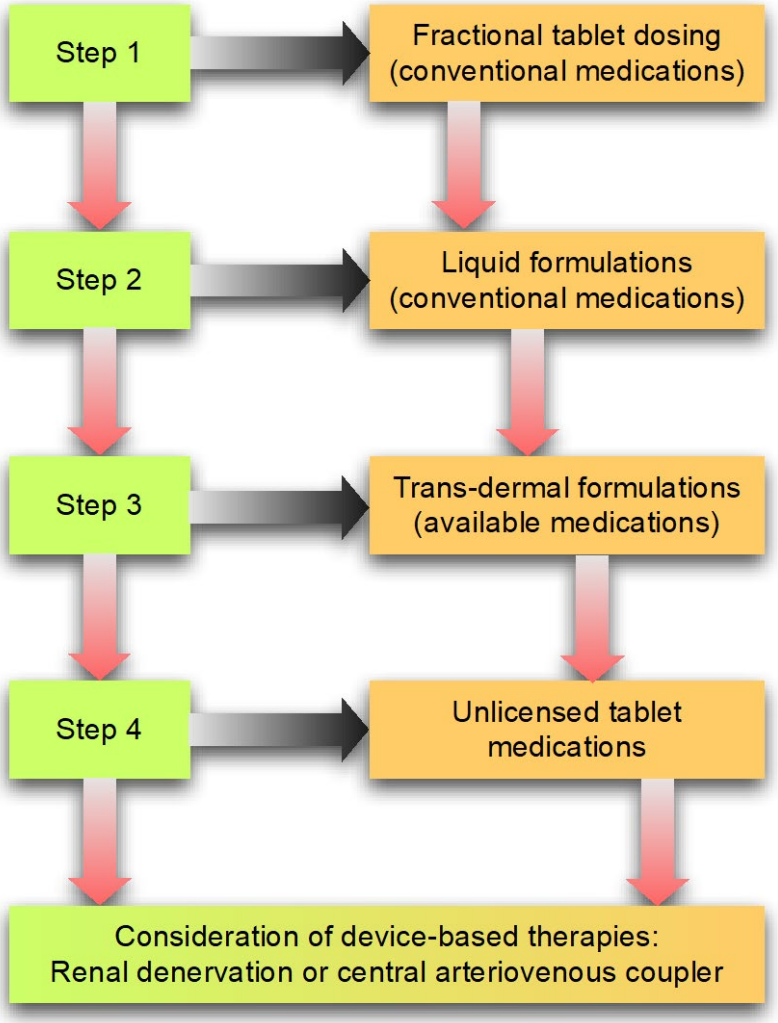
4. Patients may be reluctant to be rechallenged with previously tried medications or have persistent intolerance

repurposing of medications with licensed indications apart from hypertension, such as **phosphodiesterase inhibitors** and **long-acting organic nitrates**, that lower BP in small clinical trials

Antoniou et al., J Clin Hypertens 2016; 18: 129-138

Barts Health NHS Trust

Can be based on 4 principles:




Antoniou et al., J Clin Hypertens 2016; 18: 129-138

# Summary

Barts Health NHS Trust

Risk factors – non pharmacological factors are important

Detection – opportunities everywhere!

Management – drugs work!

Also think about overall CV risk

Resistant hypertension is common and associated with high levels of CV morbidity

Adherence is a significant problem that is easy to detect but difficult to manage

Lifestyle changes can make very large differences to BP control

Defined treatment algorithms can improve BP control

Tips and tricks

# High Blood Pressure

## What is It? How to Check?
## What Can Go Wrong....?
## How to treat?

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