Remote Hypertension Screening in Naturopathic Care:
A Prevention Model for Heart Disease and Stroke

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Disclosures

Research support
NIH-NINDS Stroke Prevention in high-risk groups
NIH LRP 2021–current

Shareholder
SMARTS Health -health tech start-up, co-founder

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Stroke Journal Journal of Americal Heart Association

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Learning Objectives

1. Review the biology, epidemiology and modifiable causes of heart disease/stroke
2. Describe hypertension as the leading driver of heart disease and stroke
3. Explain how out-of-office monitoring detects masked, nocturnal, and uncontrolled hypertension
4. Describe how wearable BP technology supports prevention-focused naturopathic care

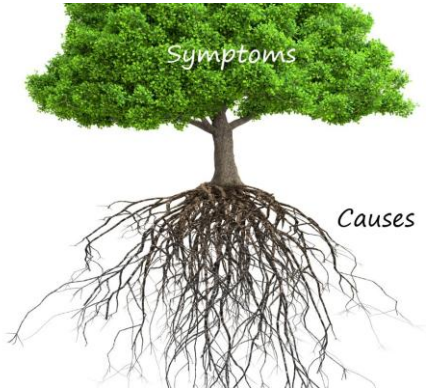
“Evolving Care Without Losing Our Roots”



Evolving biomedical technology



Better understanding



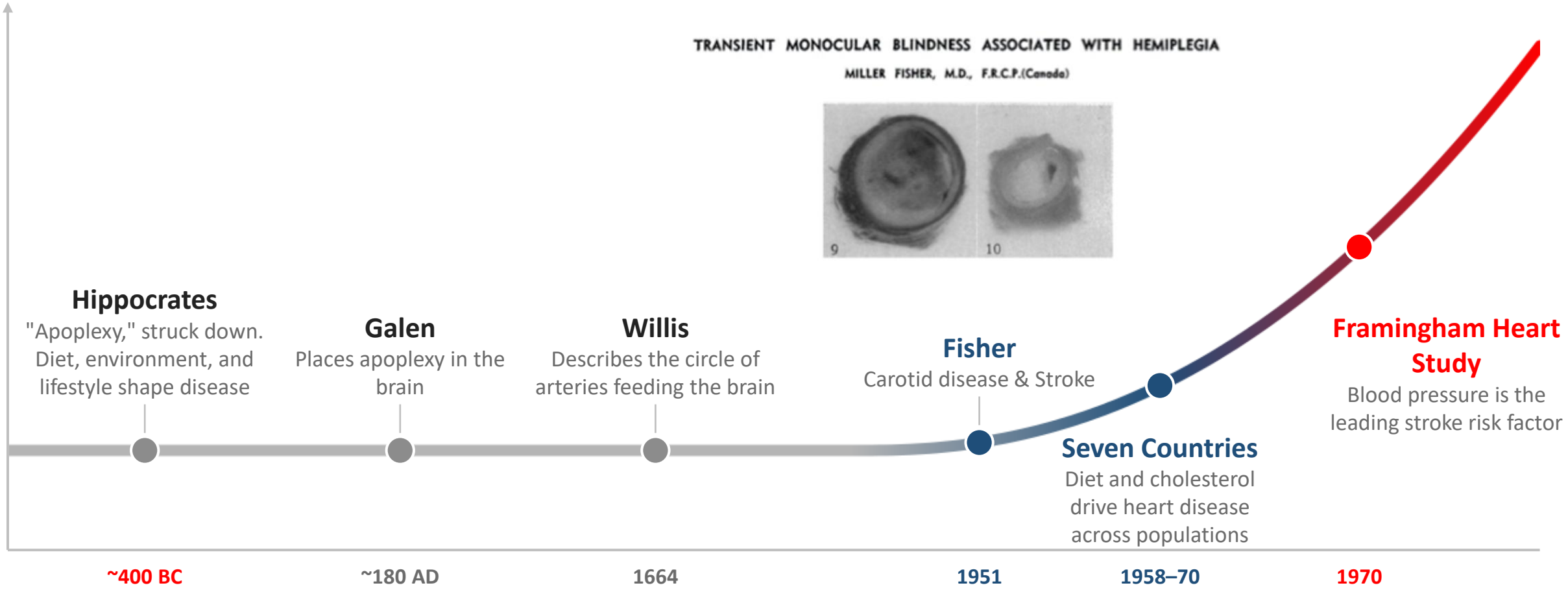
Targeting the root cause

Whole-person care for the world’s most common disease

WHO. Cardiovascular diseases fact sheet.

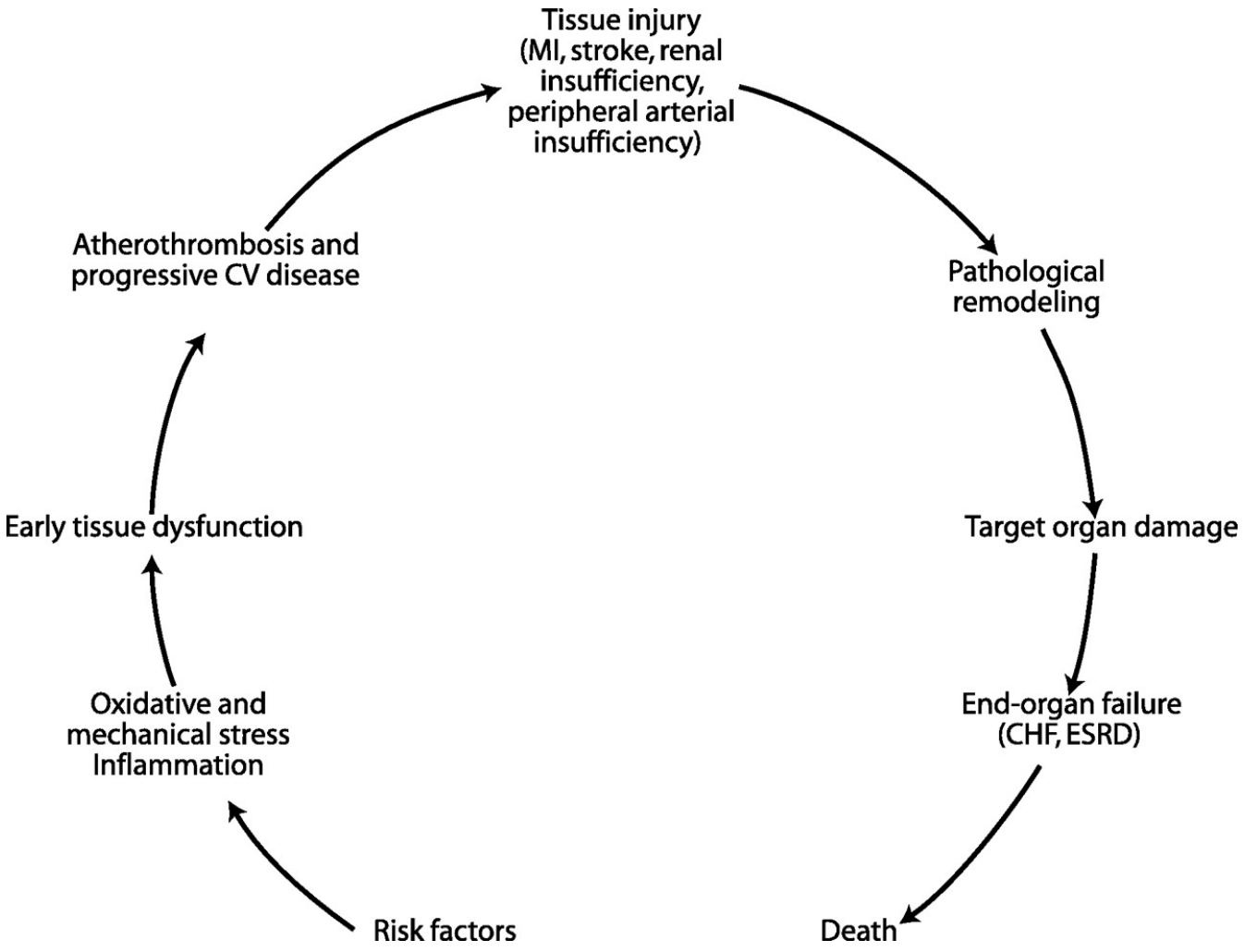
Biology and Epidemiology of Cardiovascular Disease

History of Stroke: *“struck down” to “lifelong disease”*



Hippocrates, Airs, Waters, Places. · Willis T. Cerebri Anatome, 1664. · Fisher CM. Arch Neurol Psychiatry 1951;65:346–377. · Keys A. Circulation 1970;41(suppl I). · Kannel WB, et al. JAMA 1970;214:301–310.

The Cardiovascular Continuum



One process many organs

Many risk factors, shared pathways

Endothelium fails first

Silent until the event

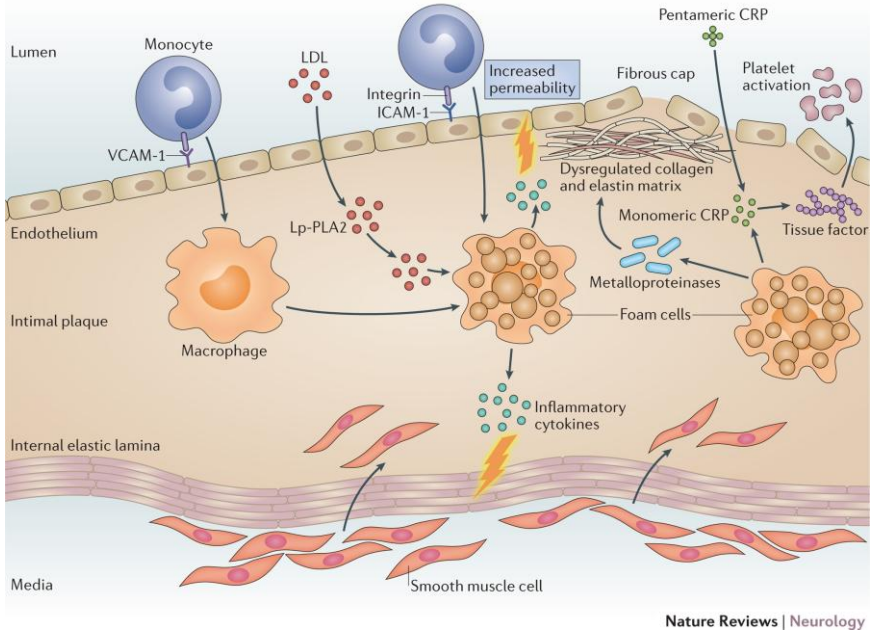
Early recognition and prevention are key

Dzau VJ, et al. The cardiovascular disease continuum validated, part I. Circulation 2006;114:2850–2870. · Dzau V, Braunwald E. Am Heart J 1991;121:1244–1263.

Atherosclerosis: A Lifelong Disease That Begins in Childhood

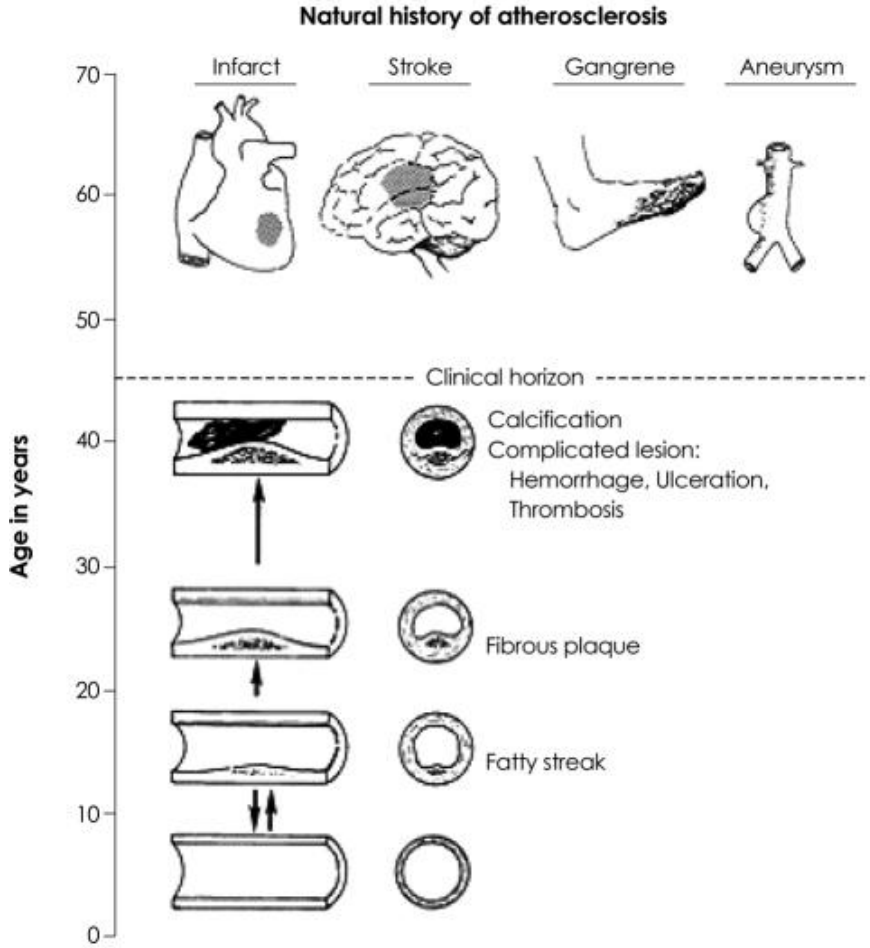
Vascular injury and inflammation

1. **Injured** endothelium lets LDL and monocytes in
2. **Inflammation** then driver for more injury



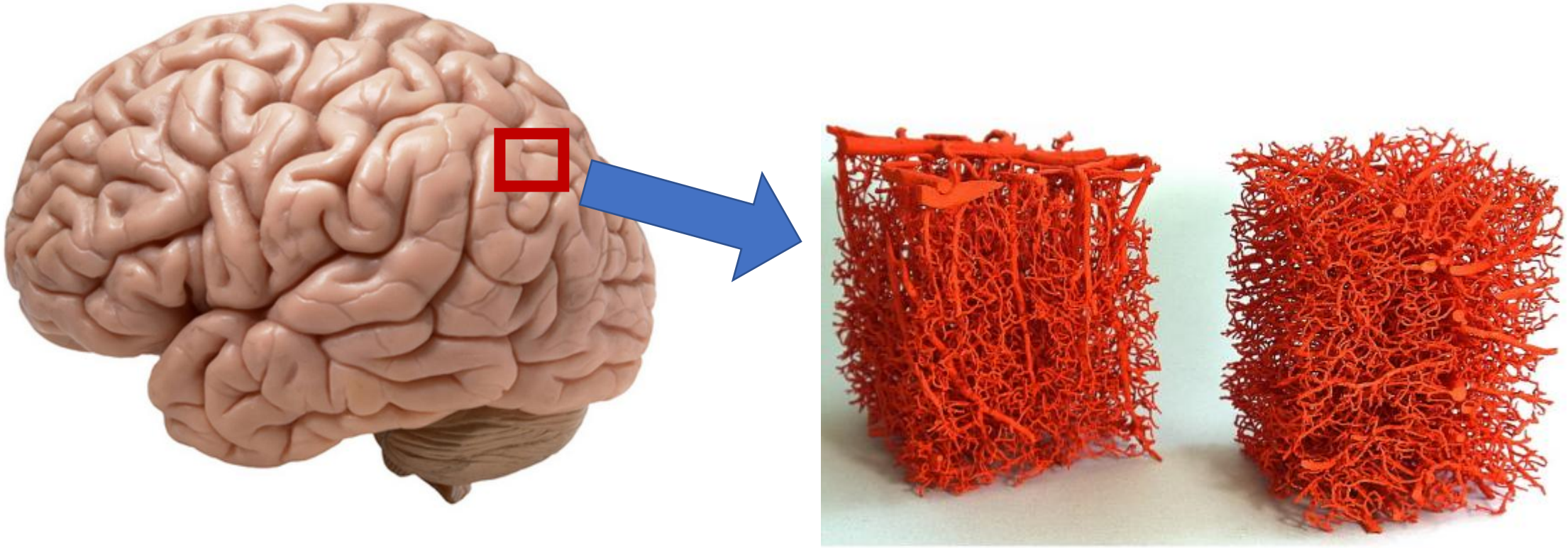
It starts early

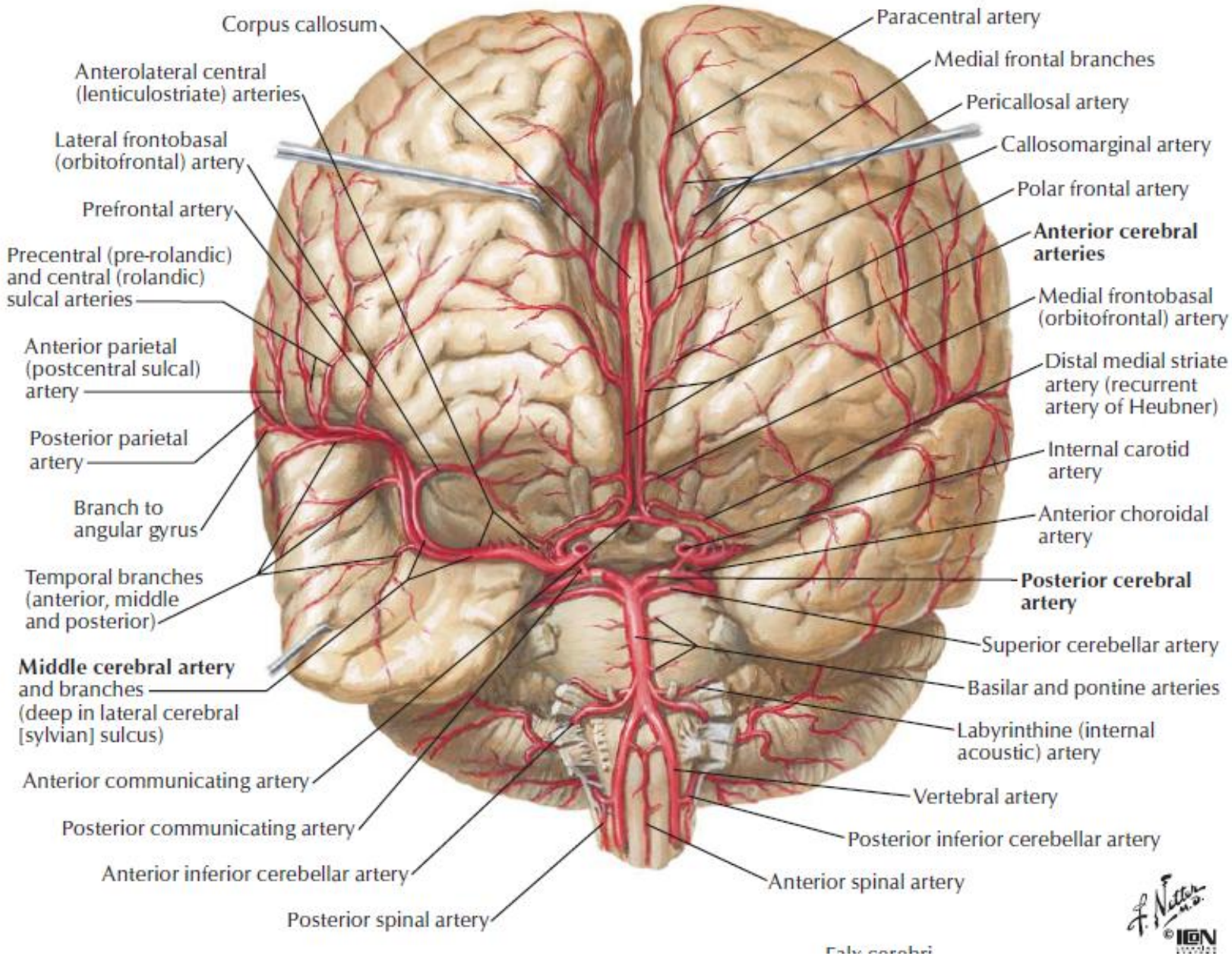
- Coronary fatty streaks in ~50% of children and 85% of adults
- **Same process in heart, brain, legs, and kidneys**



Esenwa CC, Elkind MSV. Nat Rev Neurol 2016;12:594–604.

Hong YM. Atherosclerotic cardiovascular disease beginning in childhood. Korean Circ J 2010;40:1–9 (Bogalusa Heart Study, PDAY).





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How Vascular Disease Shows Up in the Brain: Types of Stroke



Ischemic stroke
87% of strokes



Intracerebral hemorrhage
10% of strokes



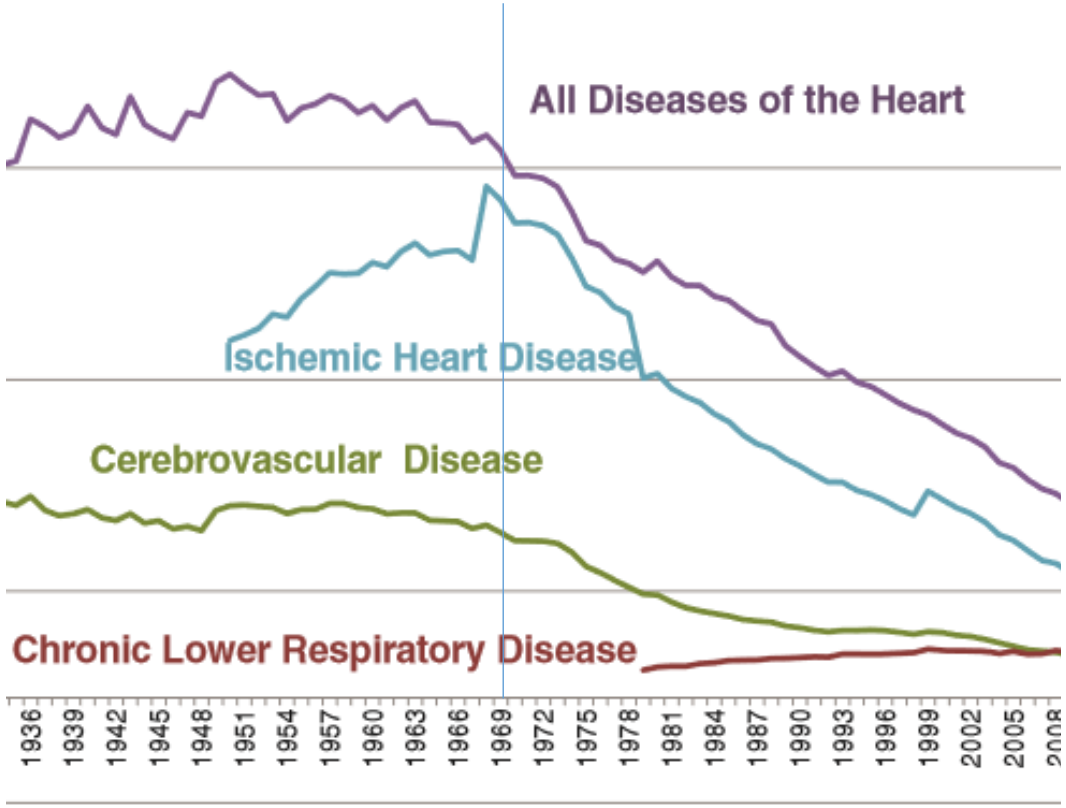
Subarachnoid hemorrhage
3% of strokes

Often no visible damage on CT

TIA
The warning

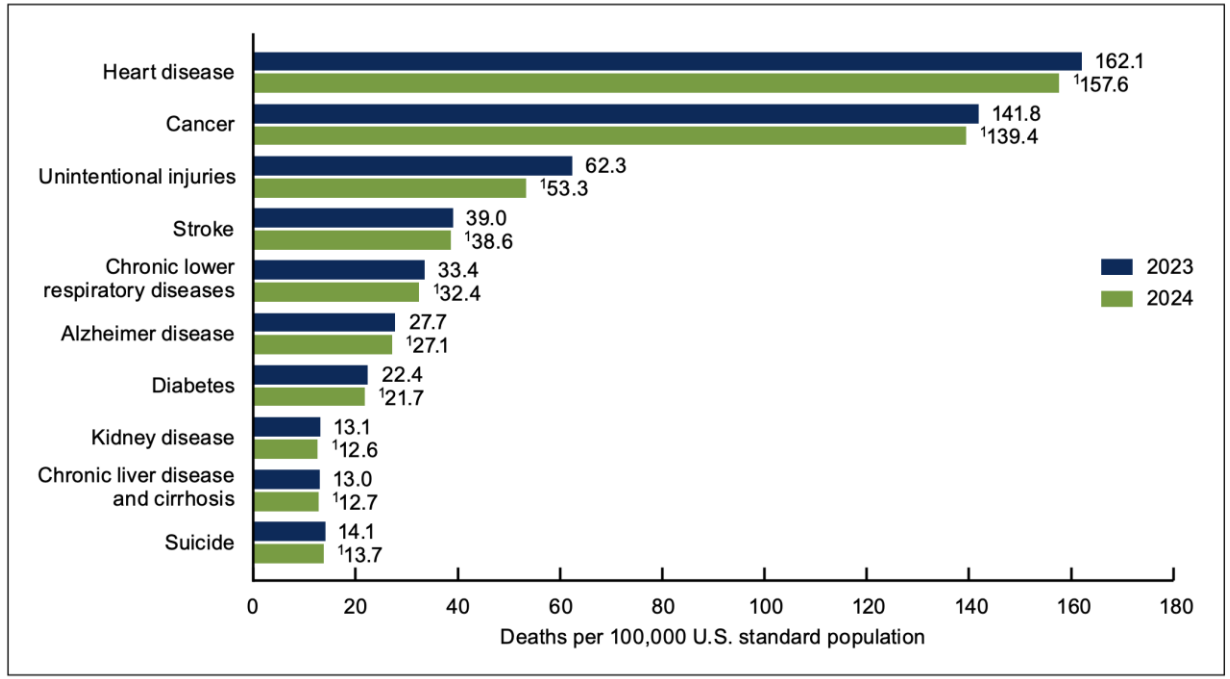
Heart Disease and Stroke Statistics 2026. Circulation 2026;153:e275–e906. · Johnston SC, et al. JAMA 2000;284:2901–2906.

Stroke Epidemiology: Mortality



Lackland. Factors Influencing the Decline in Stroke Mortality. Stroke 2014

Figure 4. Age-adjusted death rate for the 10 leading causes of death in 2024: United States, 2023 and 2024



NCHS, National Vital Statistics System, Mortality.

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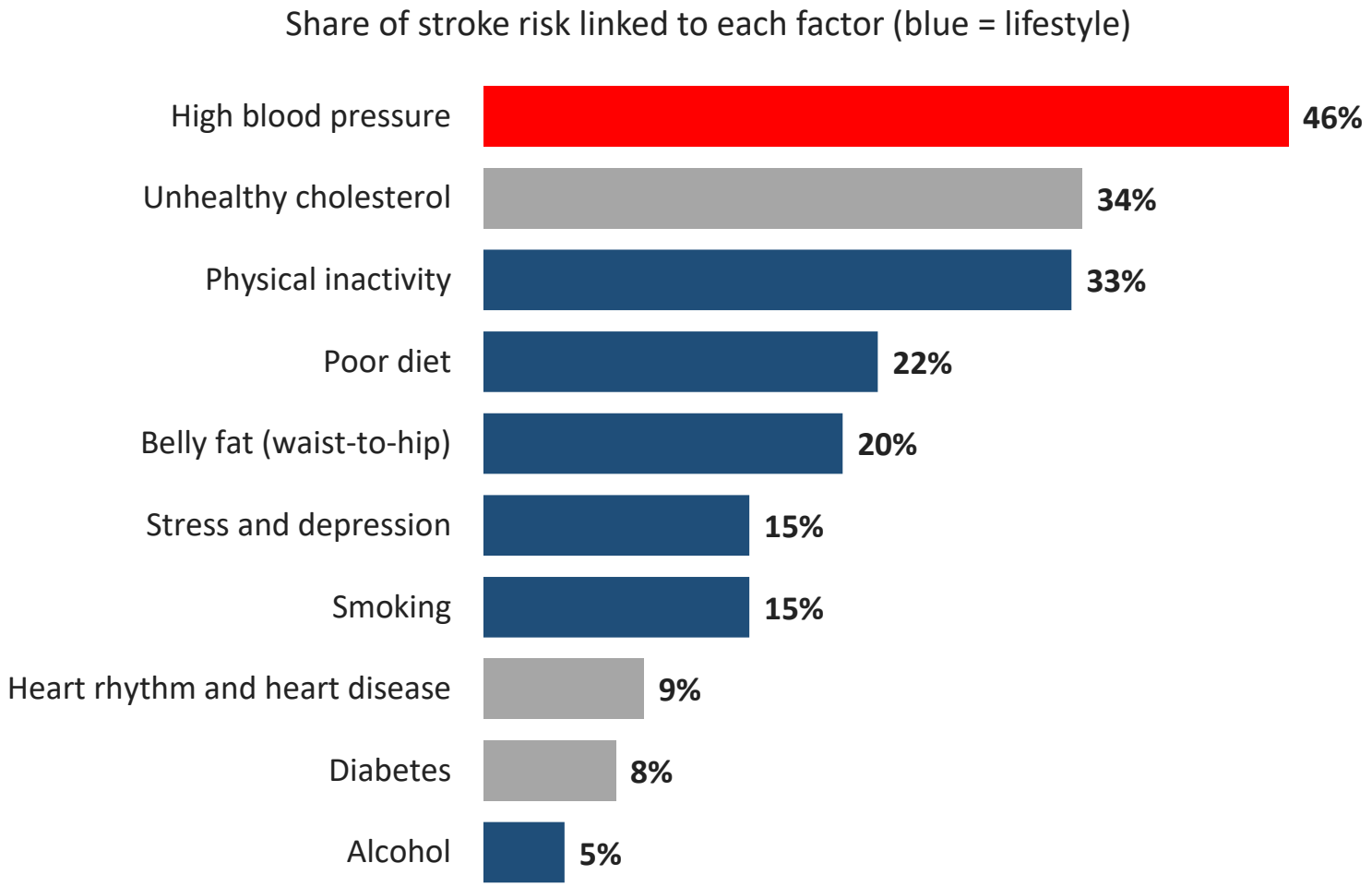
Modifiable Risk Factors and Guidelines

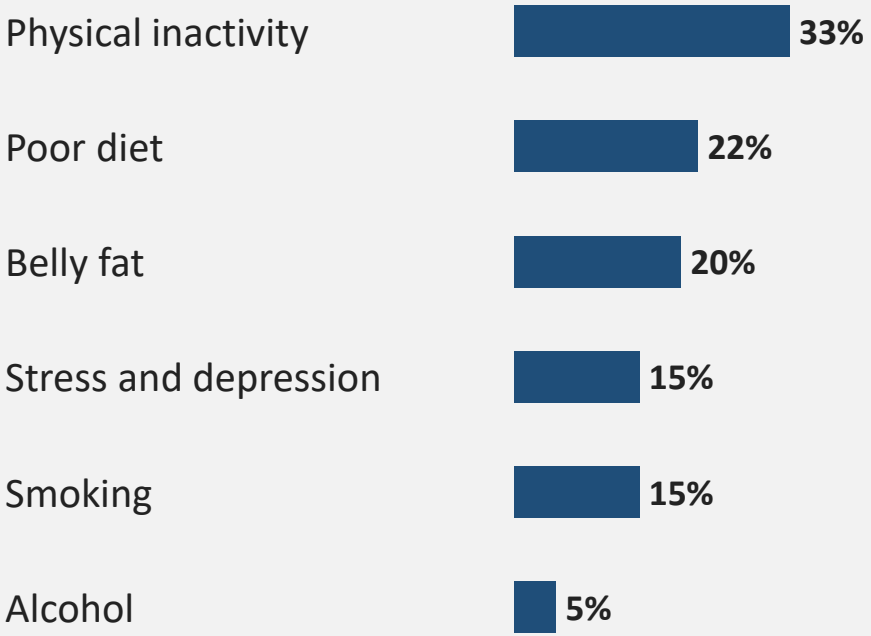
90% of Stroke Risk is Modifiable



INTERSTROKE: ~13,000 strokes and matched controls, 32 countries, 2007–2015. Factors overlap, so shares do not add to 100%. · O'Donnell MJ, et al. Lancet 2016;388:761–775. · Hankey GJ. Stroke 2020.

Lifestyle vs Blood pressure

Root causes you already treat



Share of stroke risk linked to each factor

High blood pressure

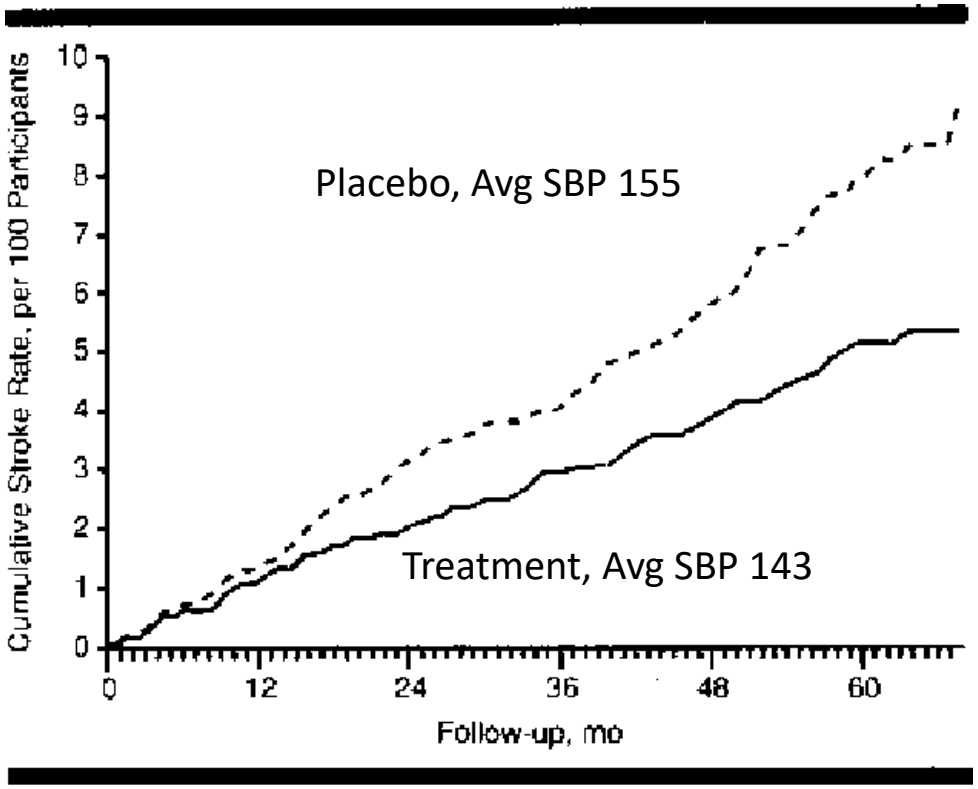
1 in 2
U.S. adults has it

4 in 10
are unaware

4 in 5
are not controlled

O'Donnell MJ, et al. Lancet 2016;388:761–775 (INTERSTROKE). · Fryar CD, et al. NCHS Data Brief No. 511, 2024 (U.S. 2021–2023: 48% prevalence, 59% aware, 21% controlled <130/80).

Hypertension & Primary Stroke Prevention



The 5-year incidence of stroke was **8.2% in the placebo group vs. 5.2%** in the treatment group

SHEP Cooperative research group. JAMA 1991

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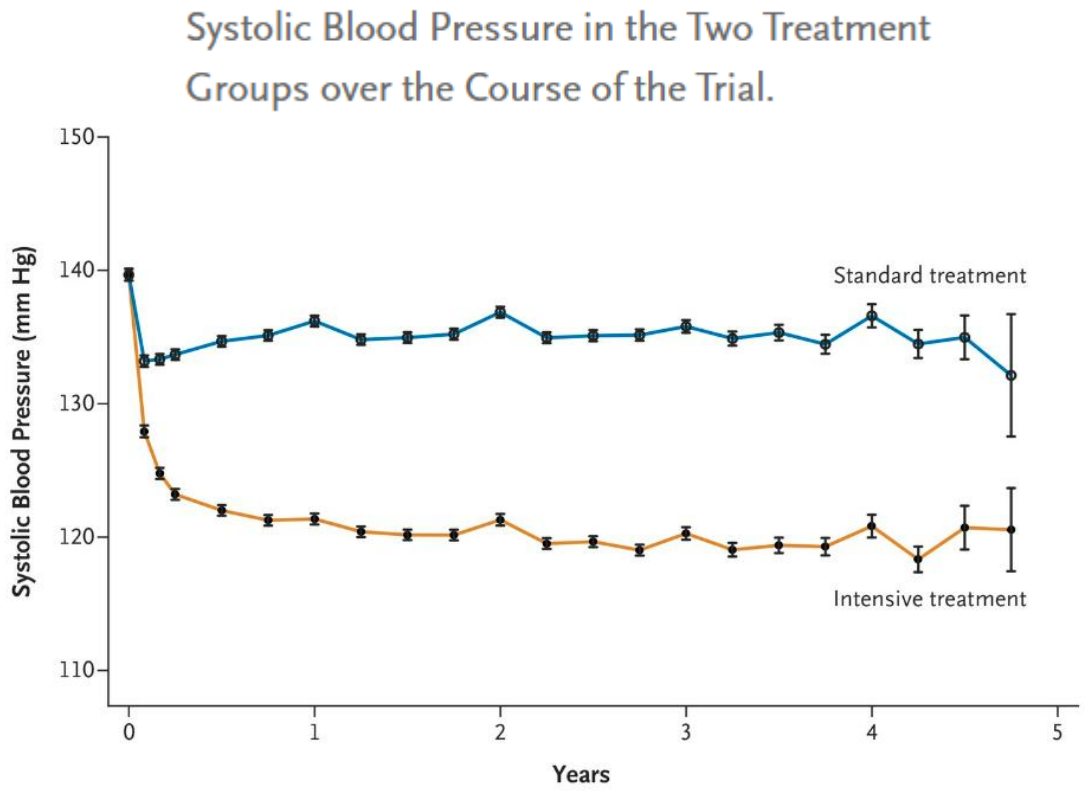
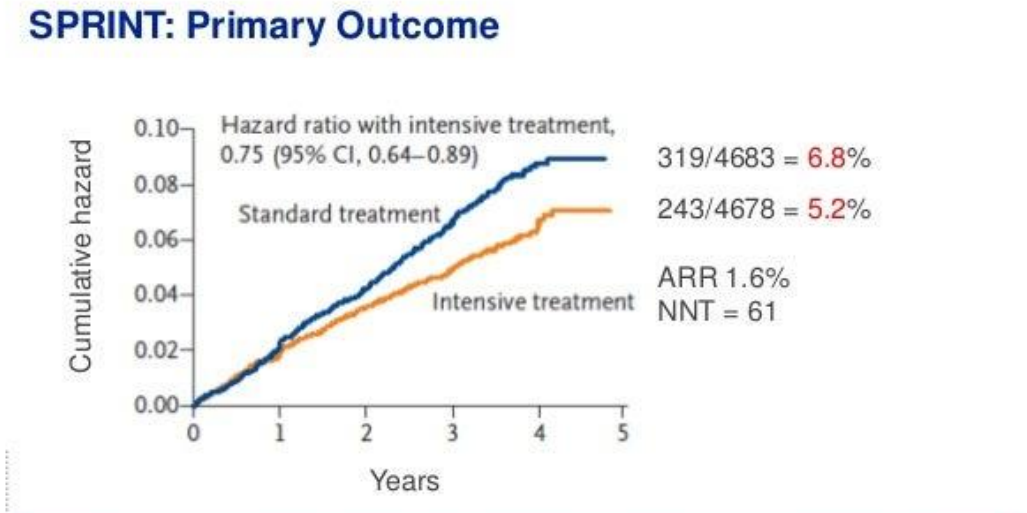
SPRINT TRIAL and Updated BP Goals



The SPRINT Research Group, NEJM 2015



Composite outcome:

myocardial infarction, other acute coronary syndromes, stroke, heart failure, or death from cardiovascular causes

Wright JT et al. *New Engl J Med* 2015;373:2103-16

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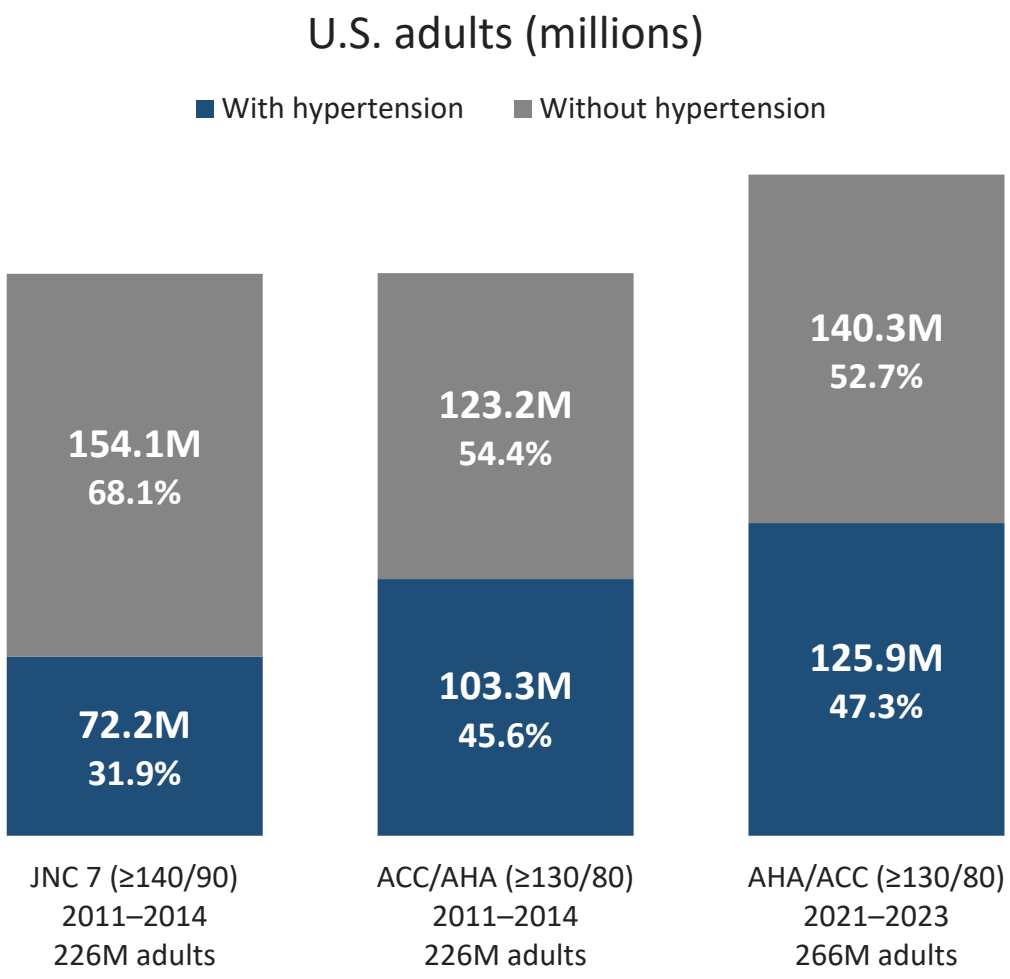
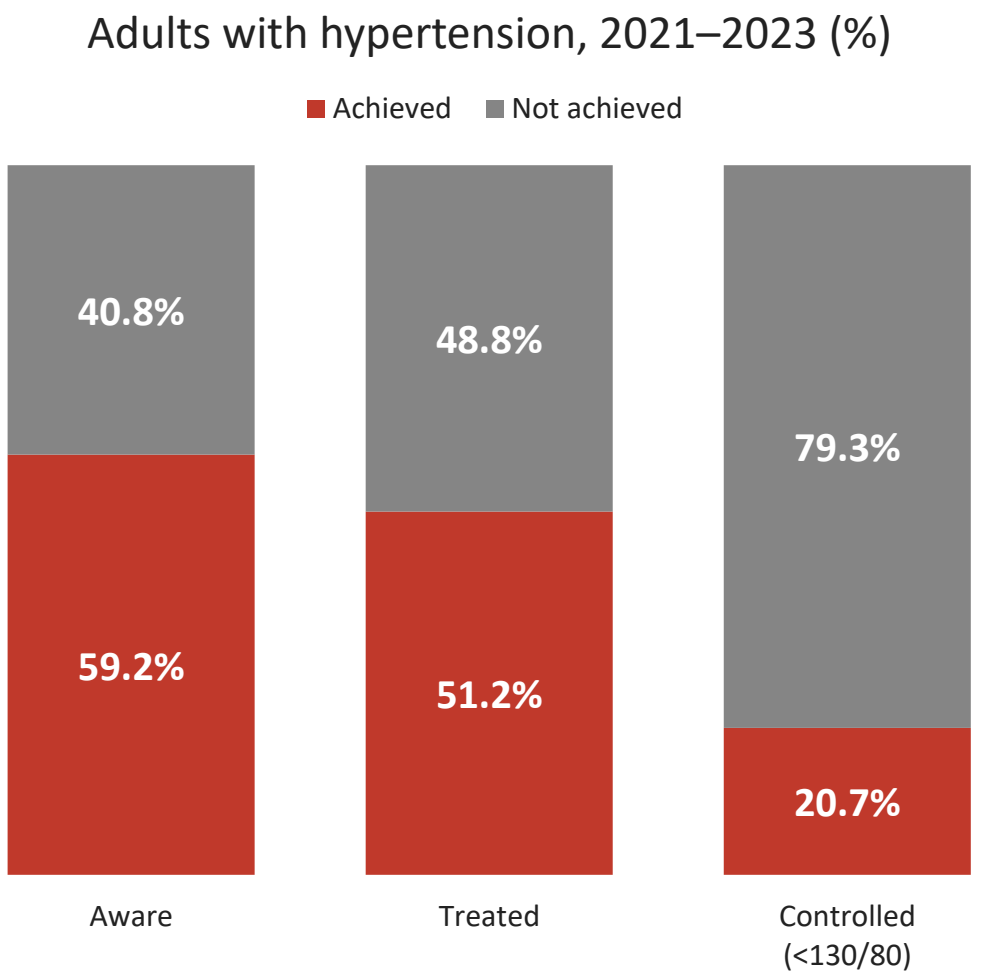
U.S. Hypertension Prevalence Under Current Definitions





Muntner P, et al. Circulation 2018;137:109–118. · Heart Disease and Stroke Statistics 2026. Circulation 2026;153:e275–e906. · Fryar CD, et al. NCHS Data Brief No. 511, 2024.

Redefinition of Hypertension in Updated Clinical Guidelines

2014
JNC 8

- Goal <140/90 for adults <60 years
- Goal <150/90 for adults ≥60 years

2017
ACC/AHA

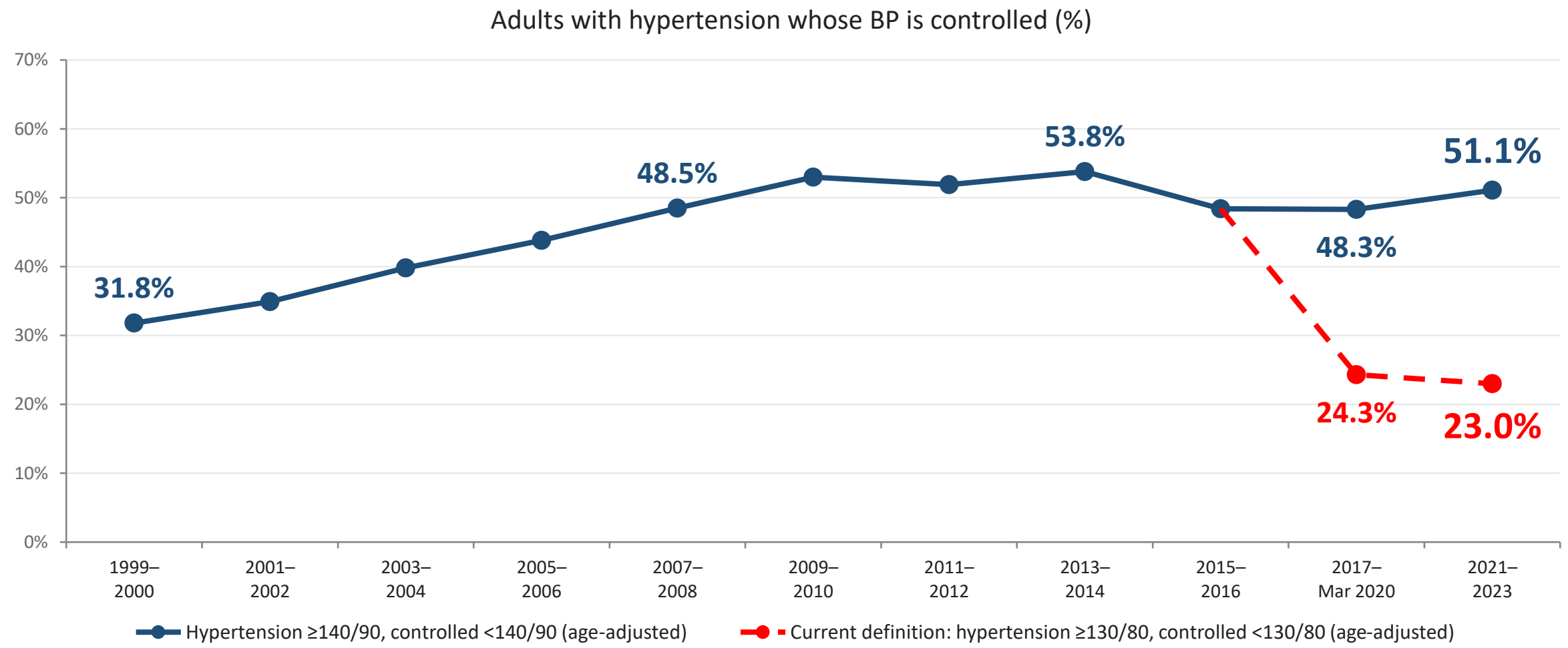
- Hypertension redefined: BP ≥130/80
- Start medication at ≥130/80 if ASCVD risk ≥10% or existing CVD; otherwise at ≥140/90
- Goal <130/80 for everyone on drug therapy

2025
AHA/ACC + 11 societies

- Hypertension still ≥130/80, confirmed with home or ambulatory readings
- Stage 1 (130–139/80–89): medication if CVD, diabetes, CKD, or 10-yr risk ≥7.5%; otherwise 3–6 months of lifestyle change first
- Stage 2 (≥140/90): start 2 drug classes, ideally as a single-pill combination
- Goal <130/80 for all, with encouragement toward systolic <120

James PA, et al. JAMA 2014;311:507–520. · Whelton PK, et al. Hypertension 2018;71:e13–e115. · Jones DW, et al. J Am Coll Cardiol 2025;86:1567–1678.

Blood Pressure Control in the United States, 1999–Today



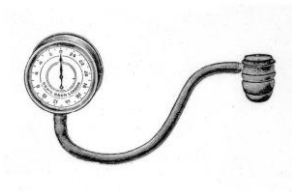
Muntner P, et al. JAMA 2020;324:1190–1200. · Hardy ST, et al. Am J Hypertens 2025;38:120–128.

Diagnosing Hypertension: Office to Home Continuum

History of Measuring Blood Pressure



1733
Hales
Blood rises in a glass tube placed in a horse's artery



1881
von Basch
First noninvasive sphygmomanometer



1896
Riva-Rocci
Inflatable arm cuff with a mercury column



1905
Korotkoff
Stethoscope sounds give systolic and diastolic



1976
Automated cuff
Dinamap: first oscillometric monitor



1980s
Automated ABPM
Readings every 15–30 minutes for 24 hours



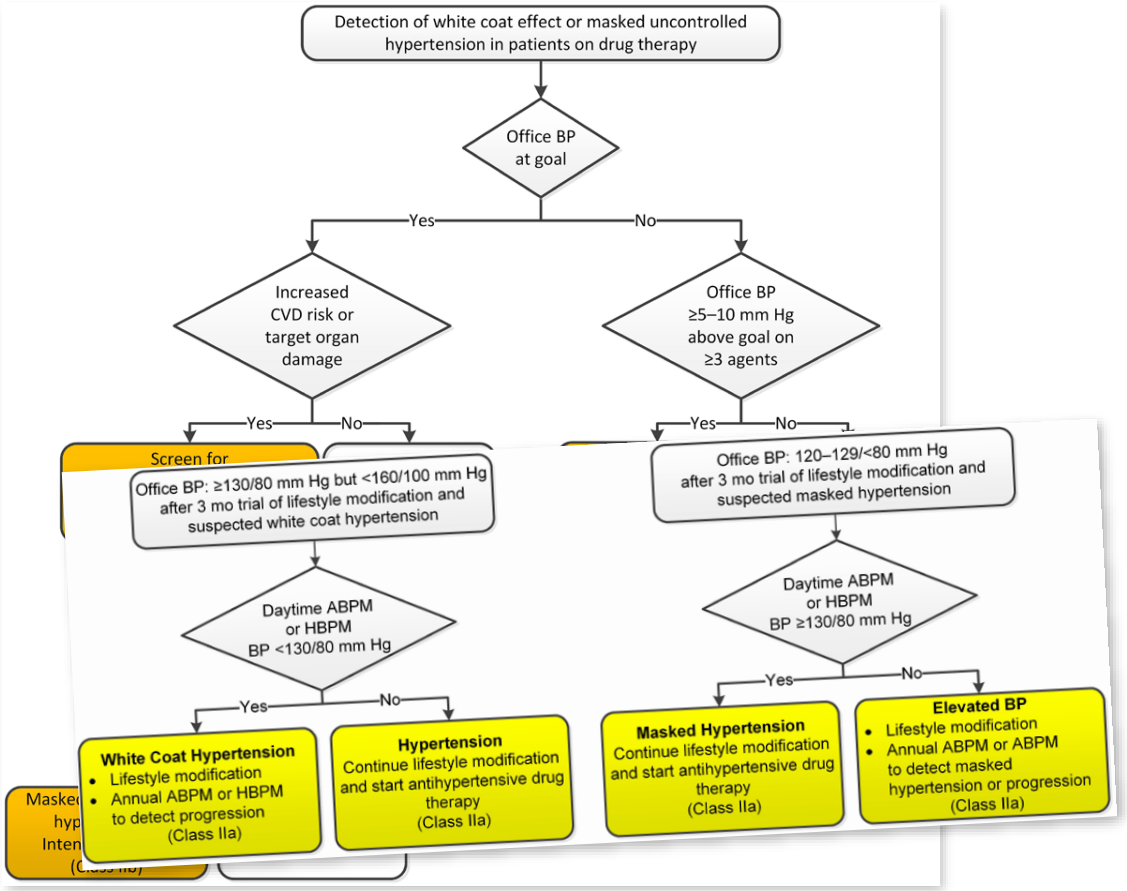
2000s
Home monitors
Validated automated cuffs used at home



2020s
Cuffless PPG
Bracelets, watches, and patches read the pulse wave

Hales S. Statical Essays: Haemastaticks, 1733. · Riva-Rocci S. Gazz Med Torino 1896. · Korotkoff NS, 1905. · Cohen JB, et al. Hypertension 2025. · Images: Wood Library-Museum of Anesthesiology (Dinamap 1045); Hilo (bracelet).

Diagnosing Blood Pressure in The Office



14 setup rules before every reading

28 readings over 7 days (minimum 12 over 3)

2 competing home cutoffs: 130/80 or 135/85

4 possible diagnoses, each with a different next step

2 separate flowcharts: untreated vs on treatment

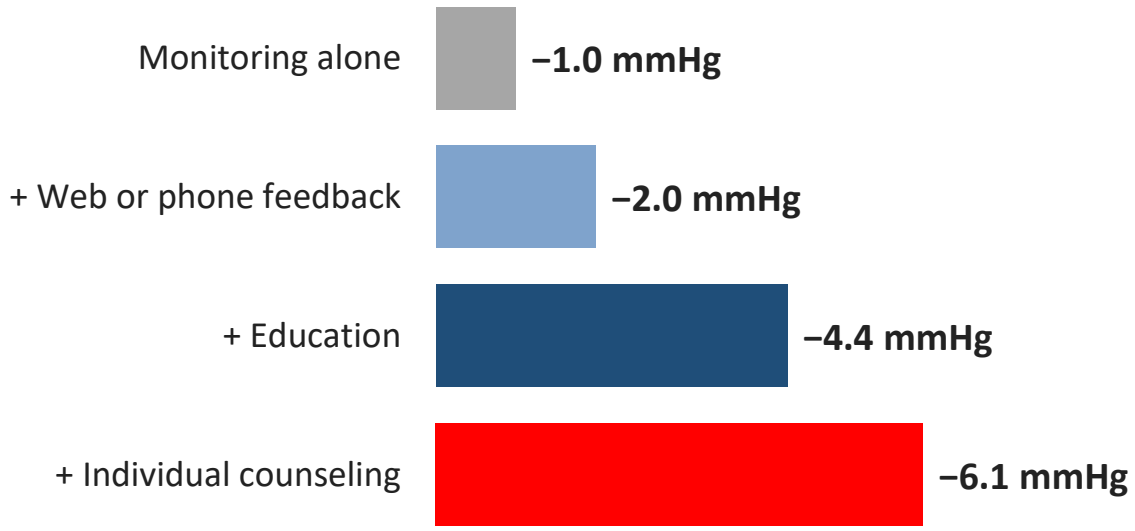
Hard for clinicians to track. Nearly impossible for patients.

Shimbo D, et al. Self-measured blood pressure monitoring at home: a joint policy statement from the AHA and AMA. Circulation 2020;142:e42–e63 (Figures 1–2, Table 3, technique section).

Does added support help

More support, bigger effect

20 trials, 6,300 patients pooled; systolic change at 12 months vs usual care

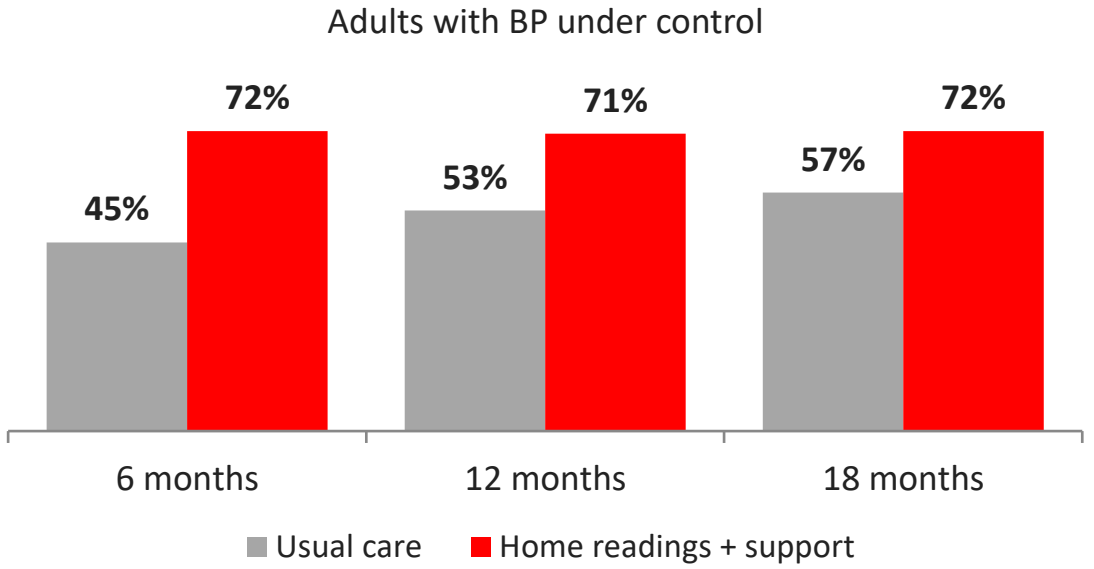


With counseling: **2.3× more likely to reach BP control**

Monitoring alone: no significant benefit

A real-world example

Home readings sent to a pharmacist who adjusted care (450 adults)



Systolic BP 10.7 mmHg lower at 6 months

Tucker KL, et al. PLoS Med 2017;14:e1002389 (as summarized in Shimbo D, et al. Circulation 2020;142:e42–e63, Table 4). · Margolis KL, et al. HyperLink. JAMA 2013;310:46–56.

Ambulatory BP Monitoring: The 24-Hour Picture

What it is

A portable cuff that reads BP every 15–30 minutes by day and every 30–60 minutes during sleep

First used clinically

1962

First portable recorder (Hinman)

Today: the reference standard in clinical trials

Benefits

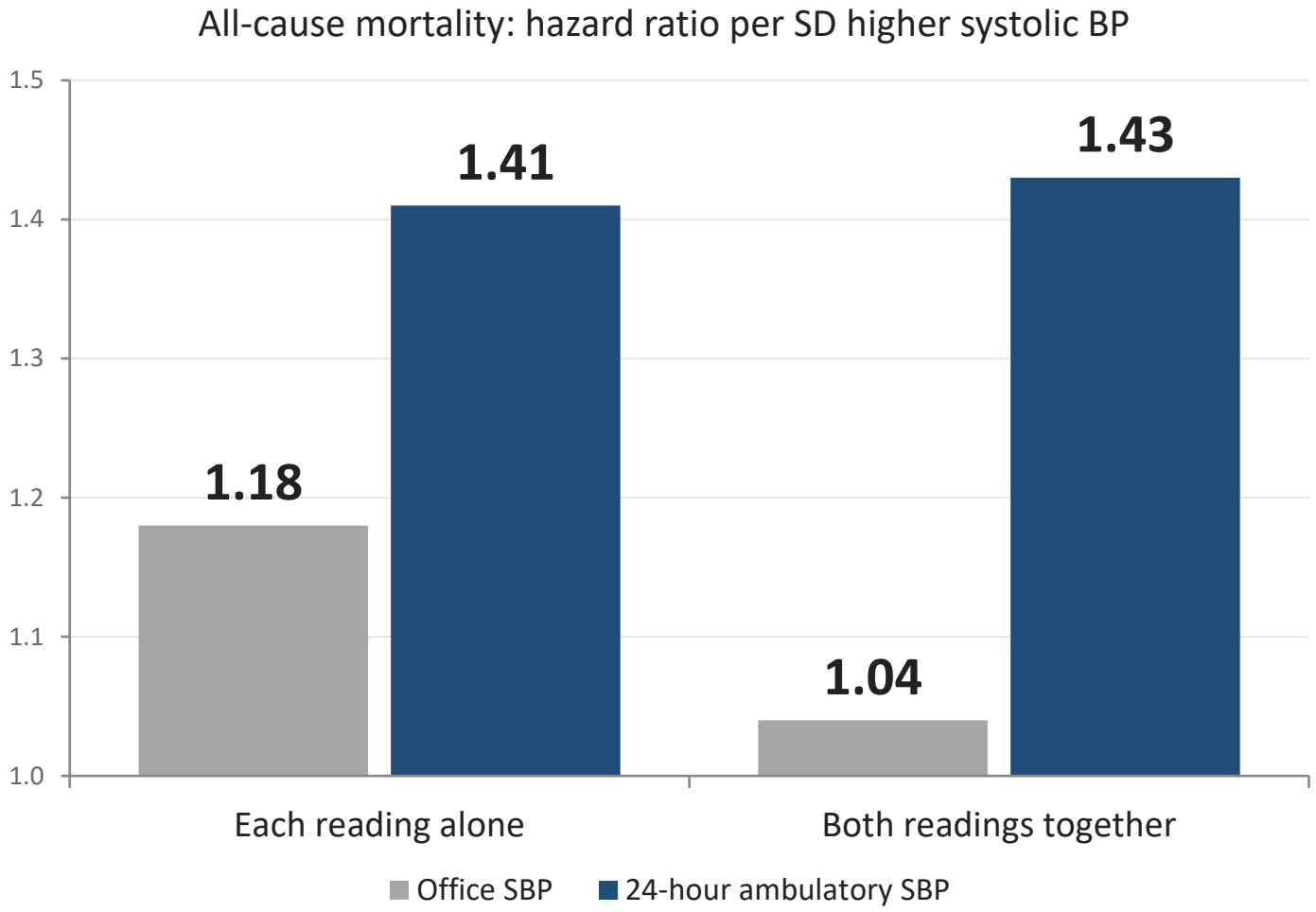
- Only routine test that captures nighttime BP, the strongest predictor of risk
- Finds white-coat and masked hypertension
- Real readings during daily life and sleep
- Catches BP that swings up and down
- High accuracy for diagnosis and predicting risk

Downsides

- Burdensome: repeated cuff squeezes, disrupted sleep, arm held still
- Higher cost and harder to access
- One 24-hour snapshot, so poor for tracking treatment
- Needs enough valid readings (about 20 day, 7 night)
- Not proven better than good home monitoring

Demko J, Cohen JB. Ambulatory blood pressure monitoring. JAMA Intern Med 2026;186:760–761. · Hinman AT, Engel BT, Bickford AF. Am Heart J 1962;63:663–668.

24-Hour Ambulatory BP is Better Than Office BP



Mortality risk vs normal BP

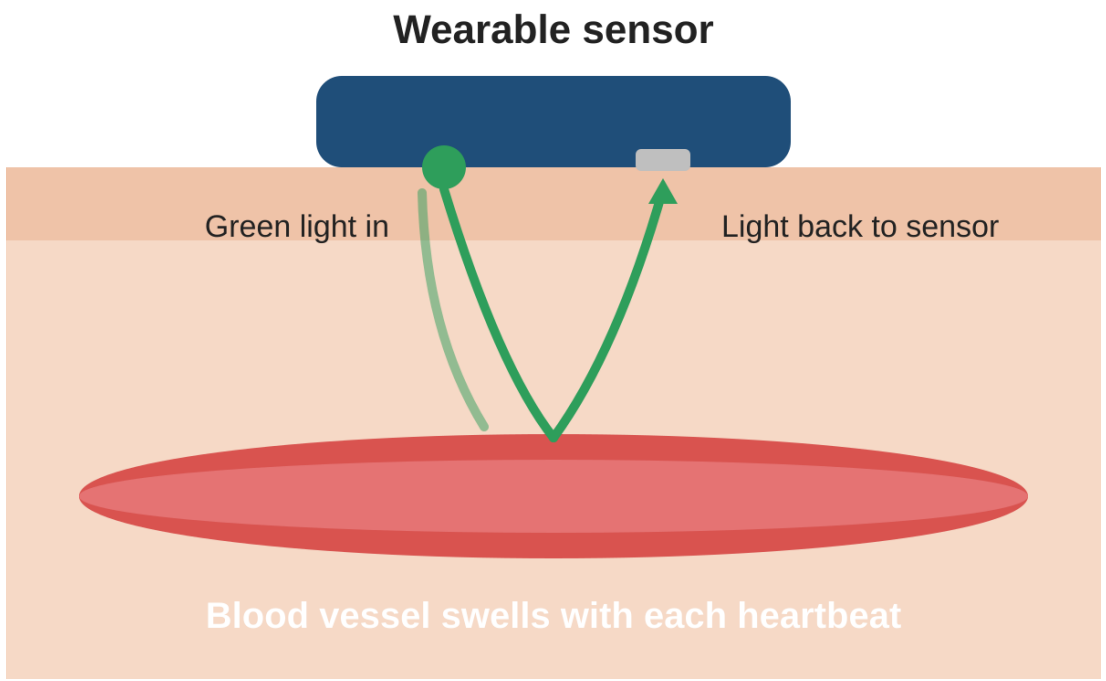
Masked hypertension
Missed by office readings
HR 1.24

Sustained hypertension
High in office and out of office
HR 1.24

White-coat hypertension
High in office only
No excess risk

Spanish ABPM Registry: 59,124 patients, median follow-up 9.7 years. Staplin N, et al. Lancet 2023;401:2041–2050 (corrected reanalysis replacing the retracted Banegas et al. NEJM 2018).

Cuffless 24-Hour Monitoring: Reading BP With Light



How it works

Photoplethysmography (PPG): light measures how blood volume changes with every heartbeat



The shape and timing of each pulse wave are turned into a BP estimate, beat after beat

Worn as



Watch



Bracelet



Chest patch

Chen G, Zou L, Ji Z. A review: blood pressure monitoring based on PPG and circadian rhythm. APL Bioeng 2024;8:031501.

A Better Experience

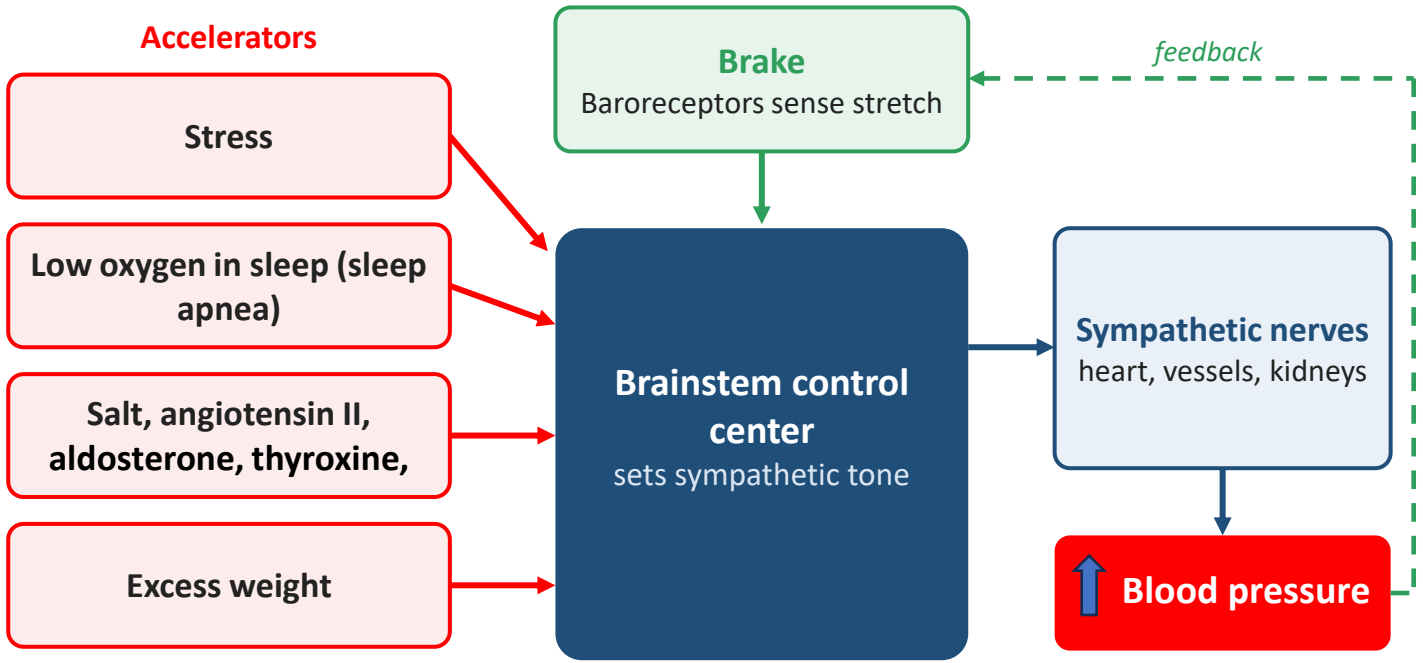
Cuff 24-hour monitor	PPG wearable
Squeezes every 15–60 minutes; about 1 in 4 report disrupted sleep	Silent, with no cuff to wake you at night
Nearly half say it interferes with daily life; many feel embarrassed	Looks like a watch or a small patch; a chest patch was rated most comfortable head-to-head

Linking BP to daily life, for root cause

- Sleep: does BP dip at night?
- Activity: how BP responds to movement
- Meals and salt: the hours after eating
- Stress: workday vs evening

Kawaja et al. PLoS One 2025;20:e0336961 (cuff vs wearable acceptance). · Chen G, et al. APL Bioeng 2024;8:031501. · Cohen JB, et al. AHA scientific statement on cuffless devices. Hypertension 2025. · Jones DW, et al. J Am Coll Cardiol 2025.

How The Nervous System Sets the Rhythm



Guyenet PG. The sympathetic control of blood pressure. Nat Rev Neurosci 2006;7:335–346 (Figures 1–2). · Kario K. Nocturnal hypertension. Hypertension 2018;71:997–1009.

Why Night Patterns are Telling Us

Normal dipping
Tone falls in sleep; the brake works

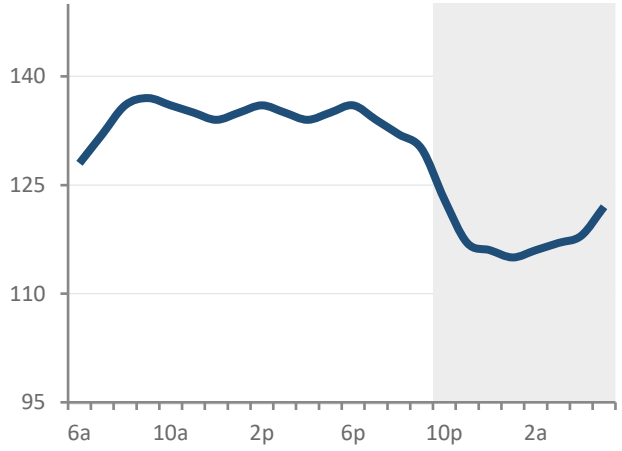
Non-dipping
Accelerator stays on at night: stress, salt, poor sleep, weight

Reverse dipping
Night surges: oxygen drops in sleep apnea, or failing autonomic control

Nighttime hypertension
Hidden overnight drive, even when daytime looks normal
(aldosterone/thyroid disease?/cortisol?/sleep apnea?)

Guyenet PG. The sympathetic control of blood pressure. Nat Rev Neurosci 2006;7:335–346 (Figures 1–2). · Kario K. Nocturnal hypertension. Hypertension 2018;71:997–1009.

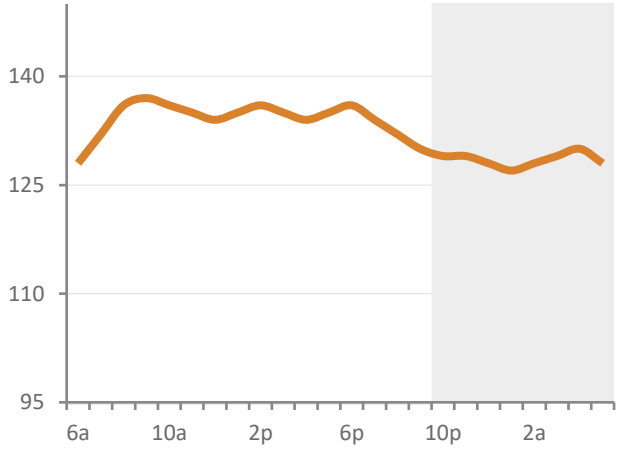
From one number to a pattern



Dipper

Night BP falls 10–20%

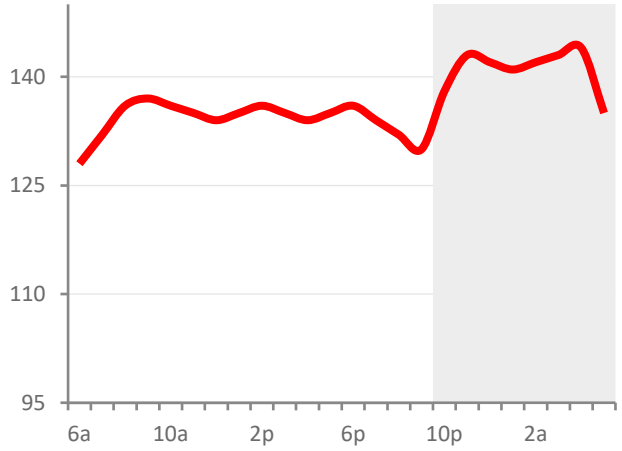
Normal: parasympathetic tone takes over during sleep



Non-dipper

Night BP falls less than 10%

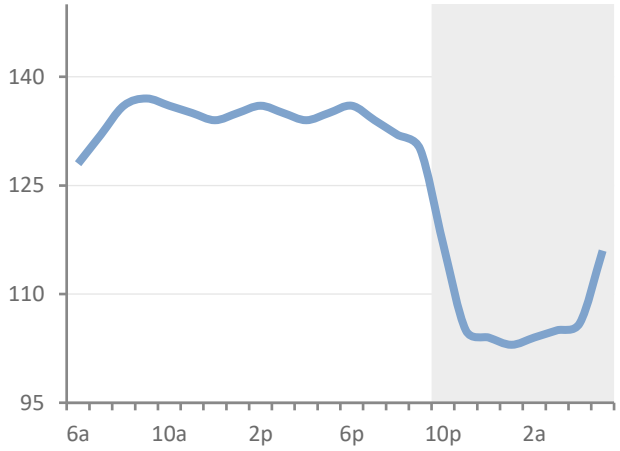
27% more CV events. Think sleep apnea, kidney disease, diabetes, salt, stress



Reverse dipper

Night BP higher than daytime

79% more CV events, ~1.8× CV death. Think Primary aldosteronism, Cushings, Pheo, Thyroid, Parathyroid,



Extreme dipper

Night BP falls more than 20%

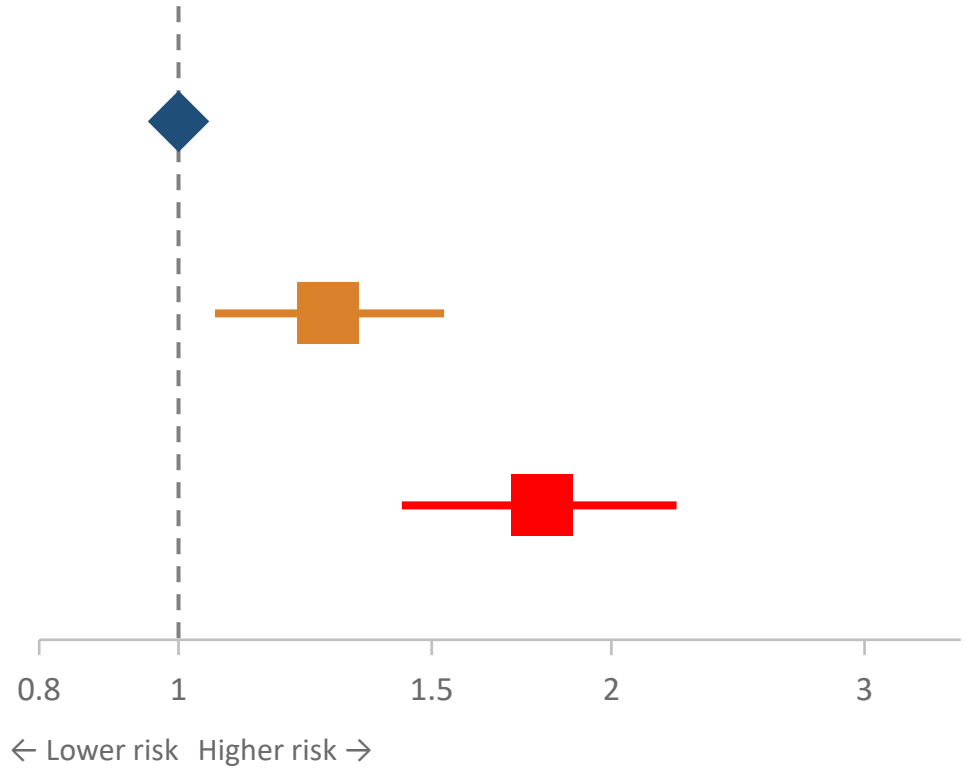
In older adults, linked to silent strokes and a steep morning surge

Schematic systolic curves; shaded band = sleep. Risks vs normal dippers from the ABC-H meta-analysis (>17,000 patients). · Salles GF, et al. Hypertension 2016;67:693–700. · Kario K, et al. Hypertension 1996;27:130–135.

Losing the Night Dip and CVD Risk

Cardiovascular events compared with normal dippers, in more than 17,000 people with hypertension

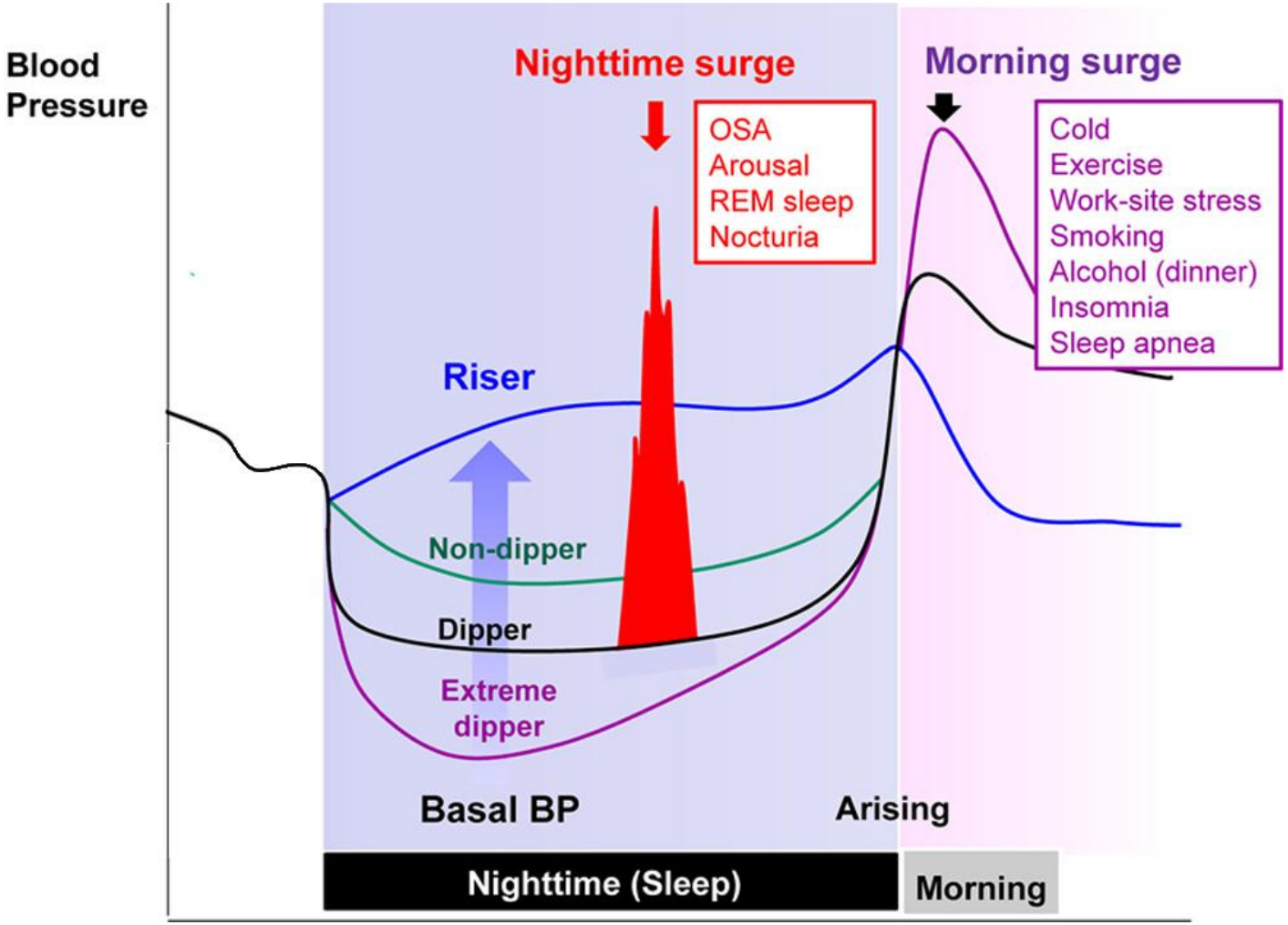
Night pattern	Hazard ratio (95% CI)
Normal dipping	1.00 (reference)
Non-dipping	1.27 (1.06–1.53)
Reverse dipping	1.79 (1.43–2.22)



The less BP falls at night, the higher the risk: 27% more events without a dip, 79% more when BP rises at night.

ABC-H meta-analysis; adjusted hazard ratios for total cardiovascular events vs normal dippers. · Salles GF, et al. Prognostic effect of the nocturnal blood pressure fall in hypertensive patients. Hypertension 2016;67:693–700.

Beyond Dipping: Night and Morning Surges



Nighttime surge

Sudden spikes during sleep, often from sleep apnea, arousals, or getting up to urinate. Averages hide them.

Morning surge

A steep rise on waking, pushed by cold, smoking, evening alcohol, poor sleep, and work stress.

Why recognize it

Heart attacks and strokes cluster in the morning hours, and nearly every trigger is a daily habit you can change.

Kario K. Nocturnal hypertension: new technology and evidence. Hypertension 2018;71:997–1009 (figure).

Prevention Strategies in at Risk Groups

Screen Every Adult: A Grade A Recommendation



USPSTF Grade A

Since 1996

Who	All adults 18 and older
Every year	Age 40+, or higher risk
Every 3–5 years	Age 18–39, normal BP, no added risk
Before treating	Confirm outside the office with 24-hour ABPM or home monitoring

US Preventive Services Task Force. Screening for hypertension in adults: reaffirmation recommendation statement. JAMA 2021;325:1650–1656.

Until Now: Knowing the Goal, Missing the Picture

1

Limited insight

A few office readings: a snapshot of a 24-hour story

2

Decisions in the dark

Hard to know who needs more, and when

3

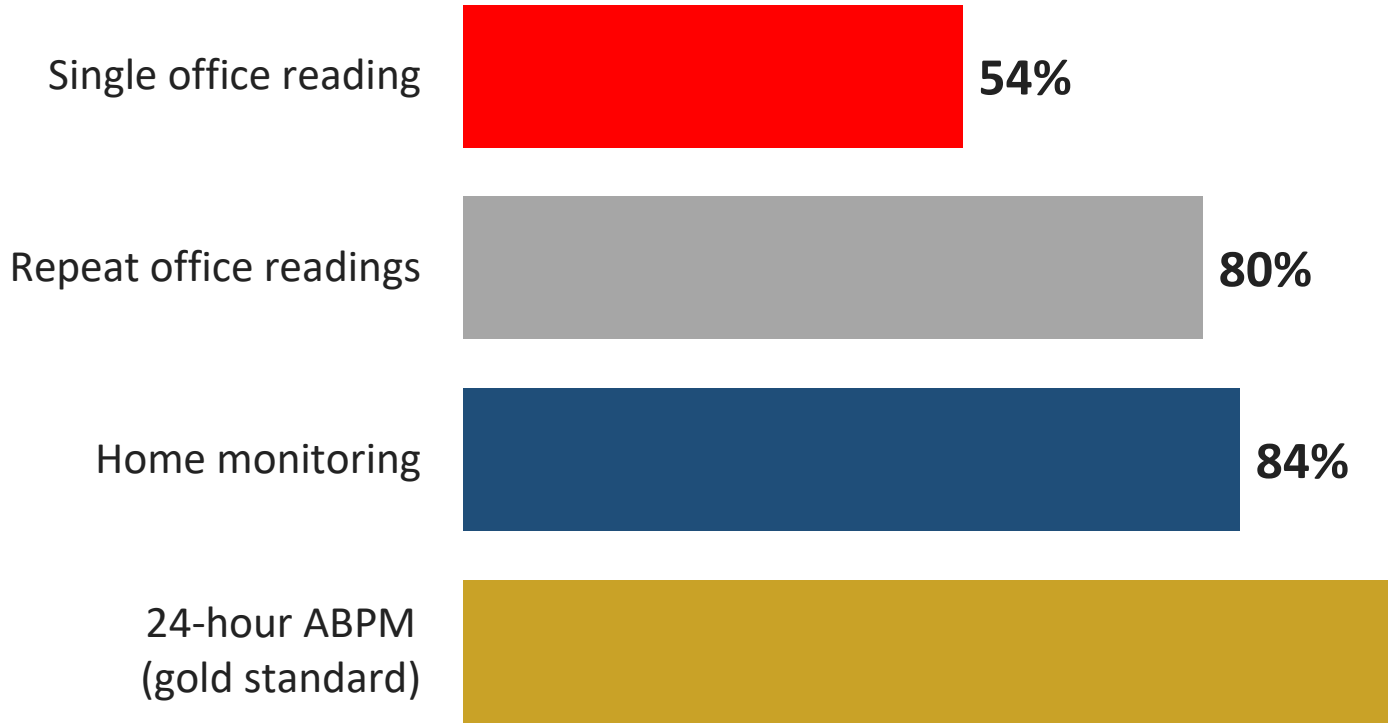
Hard-to-follow conversations

Goals have existed for decades, yet plans stay vague

Ways to screen for hypertension

How often each test catches true hypertension

Compared with 24-hour ABPM, the reference standard



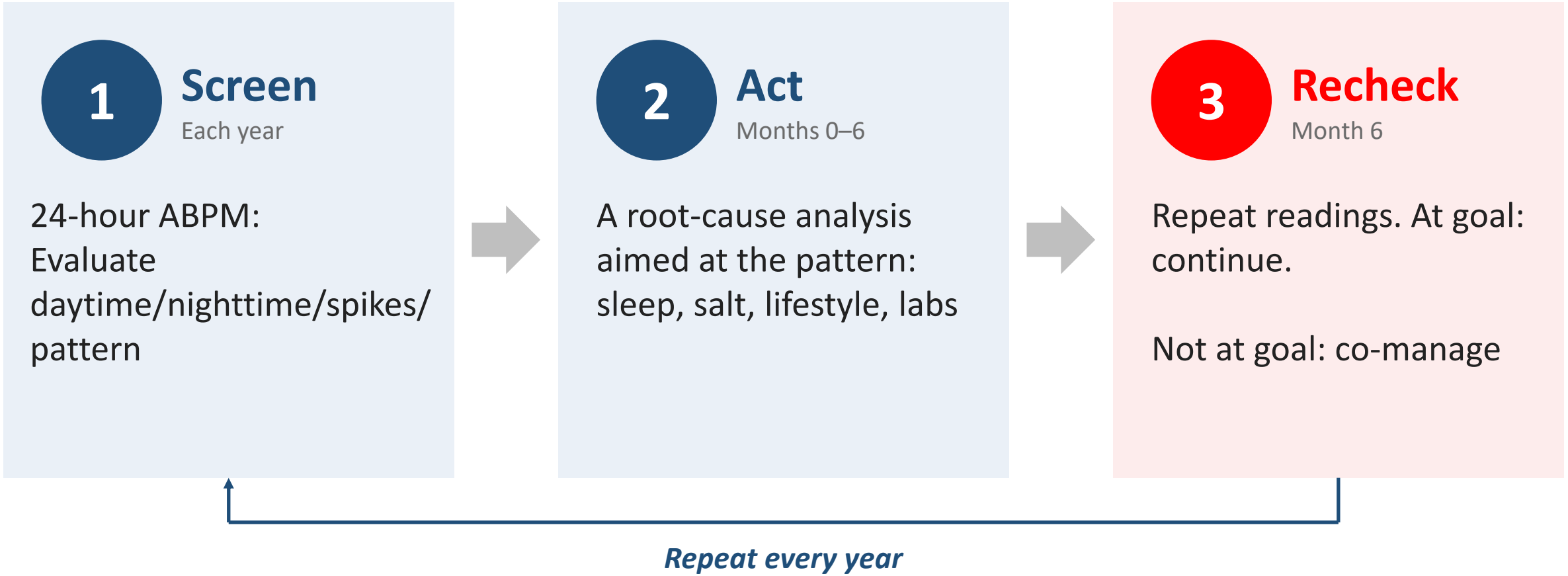
24-hour ABPM

The gold standard

- The reference test in every accuracy study the task force reviewed
- The most evidence-based information on future heart attack and stroke risk
- Home monitoring: the practical confirmation for most patients

US Preventive Services Task Force. Screening for hypertension in adults: reaffirmation recommendation statement. JAMA 2021;325:1650–1656. Sensitivities are pooled estimates from the USPSTF evidence review.

A Yearly 3-Step Plan: Screen, Act, Recheck



Proposed model. Built on: USPSTF, JAMA 2021;325:1650–1656 (out-of-office confirmation) · Jones DW, et al. J Am Coll Cardiol 2025;86:1567–1678 (3–6 months of lifestyle change before reassessment) · Shimbo D, et al. Circulation 2020;142:e42–e63 (annual out-of-office monitoring for white-coat and elevated BP).

Lower Blood Pressure, Fewer Cardiovascular Events Over Time

1 year | 5 years | 10 years



Major cardiovascular events

2.2% → 1.7%

Risk with 10 mmHg lower SBP | Events prevented | Full ring = 25% risk

Illustrative projection: SPRINT standard-treatment primary-outcome rate (2.19% per year), assumed constant, with 20% relative risk reduction per 10 mmHg lower SBP (Ettehad 2016). · SPRINT Research Group. N Engl J Med 2015;373:2103–2116. · Ettehad D, et al. Lancet 2016;387:957–967.

Lower Blood Pressure, Fewer Cardiovascular Events Over Time

1 year | **5 years** | 10 years



Major cardiovascular events

10.4% → 8.4%

Risk with 10 mmHg lower SBP | Events prevented | Full ring = 25% risk

Illustrative projection: SPRINT standard-treatment primary-outcome rate (2.19% per year), assumed constant, with 20% relative risk reduction per 10 mmHg lower SBP (Ettehad 2016). · SPRINT Research Group. N Engl J Med 2015;373:2103–2116. · Ettehad D, et al. Lancet 2016;387:957–967.

Lower Blood Pressure, Fewer Cardiovascular Events Over Time

1 year | 5 years | **10 years**



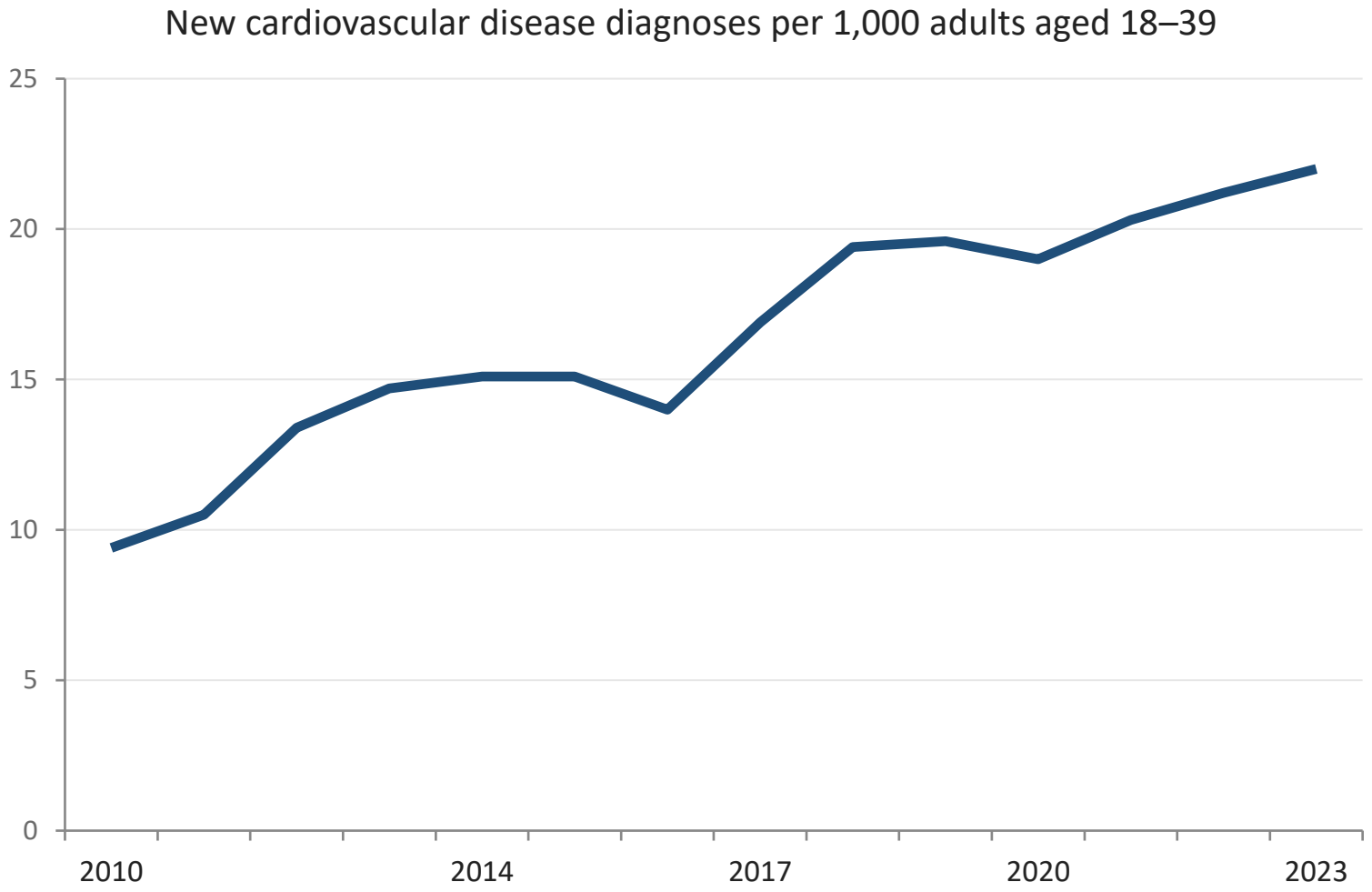
Major cardiovascular events

19.7% → 16.1%

Risk with 10 mmHg lower SBP | Events prevented | Full ring = 25% risk

Illustrative projection: SPRINT standard-treatment primary-outcome rate (2.19% per year), assumed constant, with 20% relative risk reduction per 10 mmHg lower SBP (Ettehad 2016). · SPRINT Research Group. N Engl J Med 2015;373:2103–2116. · Ettehad D, et al. Lancet 2016;387:957–967.

Young Adult under 40: Heart Disease Is Rising

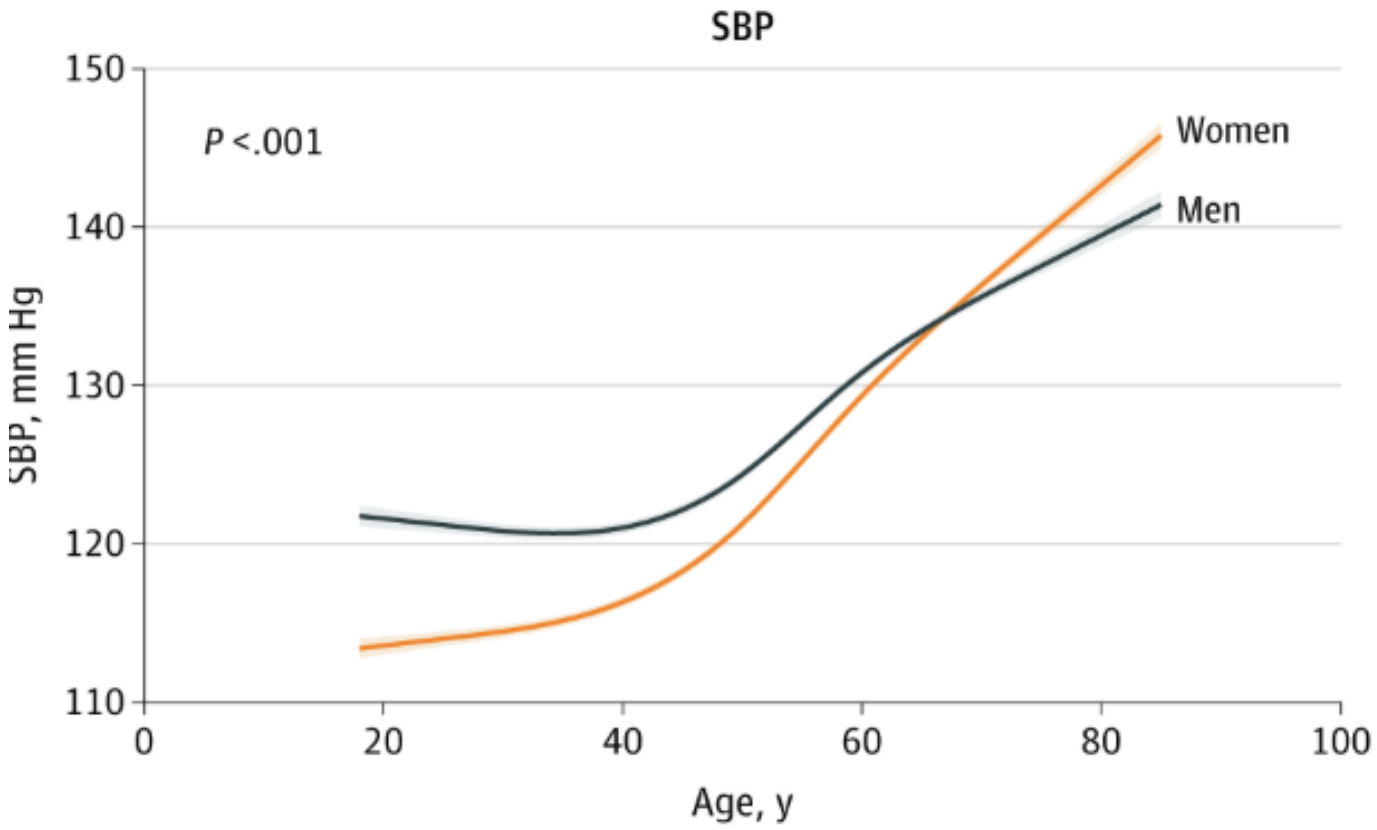


Possible reasons

- High BP, diabetes, and obesity starting younger
- Ultra-processed food, more sitting
- Short or poor sleep, chronic stress
- More testing finds more disease

Franklin B, Barkley E, Bartelt K, Deckert J. Epic Research, April 30, 2024 (25,402,650 patients aged 18–39). CVD = angina, ischemic heart disease, pulmonary embolism, valve disease, atherosclerosis. Intermediate years read from the published figure. Reasons are proposed, not tested in this analysis.

Women: Blood Pressure Across the Life Course



Start lower

Rise faster, from the 30s

Catch up by 60, then pass

32,833 adults · 144,599 BP readings · 4 U.S. cohorts · ages 5–98 · 1971–2014

Ji H, Kim A, Ebinger JE, et al. Sex differences in blood pressure trajectories over the life course. JAMA Cardiol 2020;5:255–262. Framingham, ARIC, CARDIA, MESA.

The Menopause Transition

Premenopause	Perimenopause: a window of vulnerability	Postmenopause

▲
Final period

Symptoms she feels

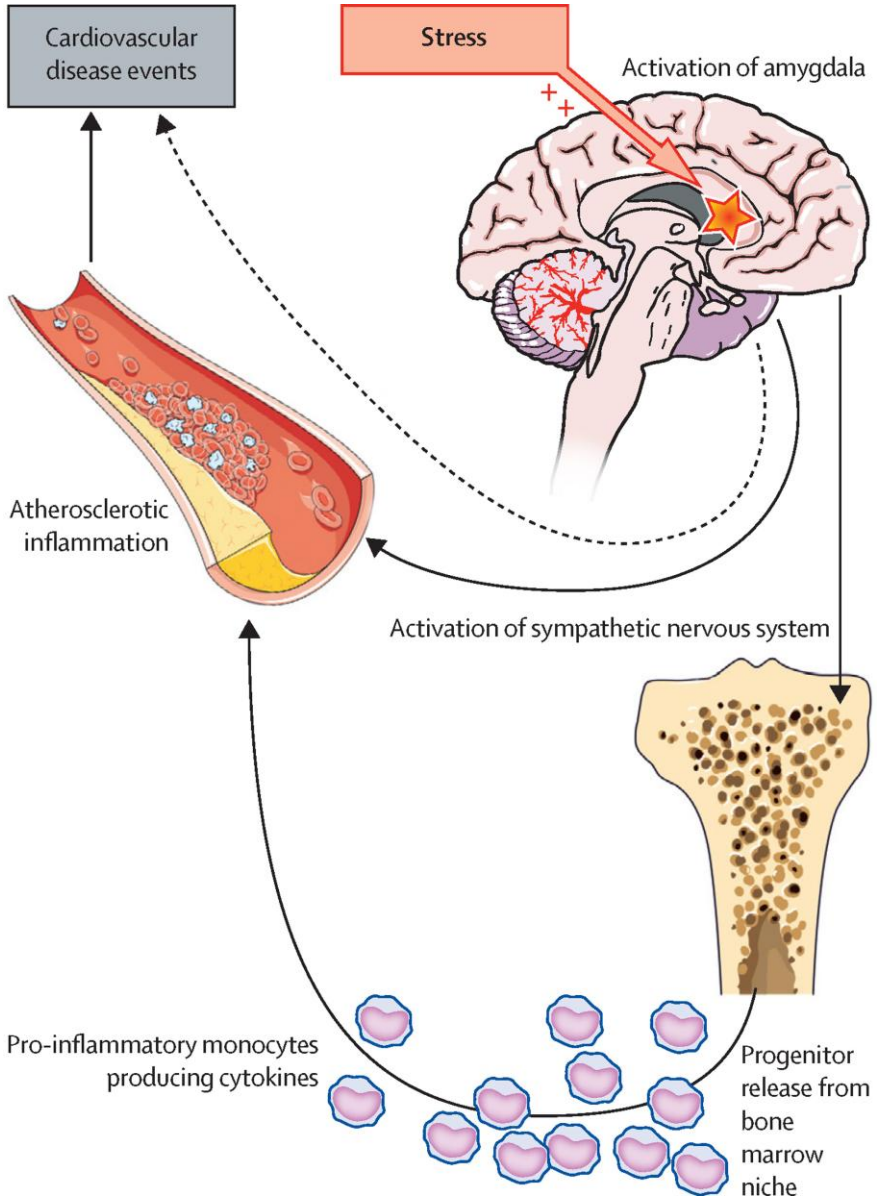
- **Hot flashes, night sweats**
- **Poor sleep**
- **Low mood, anxiety**

Changes she doesn't feel

- **LDL and apoB jump** Within a year of the final period
- **Belly fat gain doubles** Starting ~2 years before the final period
- **Arteries thicken and stiffen** Most in late perimenopause
- **BP keeps climbing** Driven mostly by age, so it is easy to miss

El Khoudary SR, et al. Menopause transition and cardiovascular disease risk: implications for timing of early prevention. AHA scientific statement. Circulation 2020;142:e506–e532.

How Stress Becomes Heart Attack and Stroke

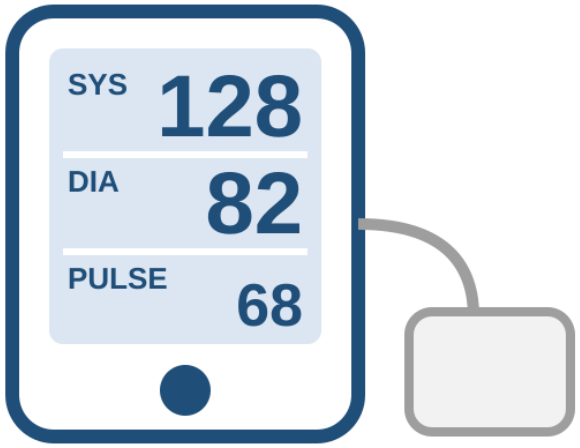


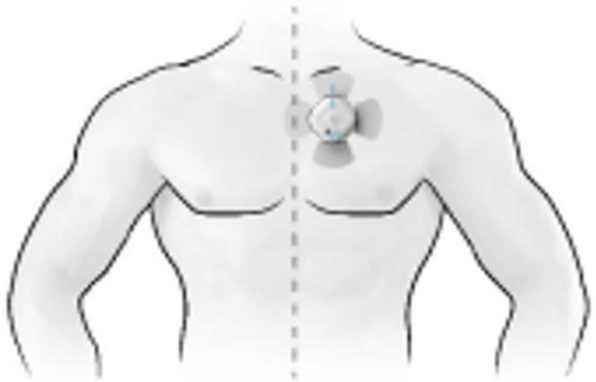
1. **Stress:** The brain's alarm center, the amygdala, switches on
2. **Fight or flight:** The sympathetic nervous system fires, and BP rises
3. **Bone marrow:** Releases more inflammatory white blood cells
4. **Arteries:** Those cells inflame plaque in the artery wall
5. **Heart attack and stroke:** Inflamed plaque is more likely to rupture

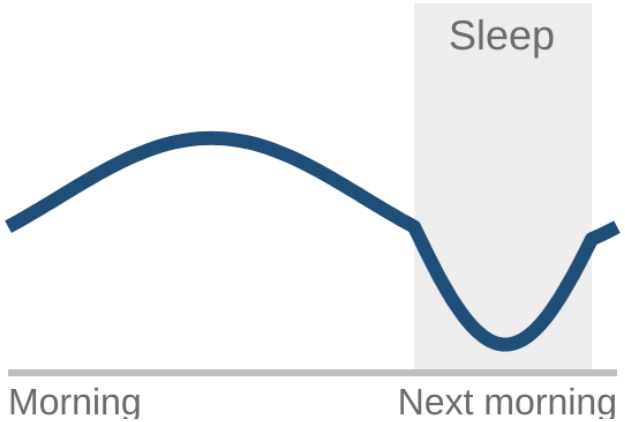
Tawakol A, Ishai A, Takx RAP, et al. Relation between resting amygdalar activity and cardiovascular events: a longitudinal and cohort study. Lancet 2017;389:834–845. Figure reproduced from the article.

The Modern Screening Model

How Cuffless Blood Pressure Monitors Work







1 Calibrate

A cuff reading at rest gives the starting point

2 Wear

A small chest patch reads the pulse of blood volume with each heartbeat

3 See the whole day

Tracks how BP rises and falls from that starting point, awake and asleep

Cohen JB, et al. Cuffless devices for the measurement of blood pressure: a scientific statement from the AHA. Hypertension 2026;83:e00254. · Hu JR, et al. Cardiovasc Digit Health J 2023;4:9–20.

The Shift to Cuffless BP Is Happening Now

FDA-cleared light-sensor (PPG) devices

2019 Biobeat chest patch and watch
First cuffless BP clearance; prescription, hospital and home monitoring

2025 Hilo Band (wrist)
First over-the-counter cuffless wellness BP monitor

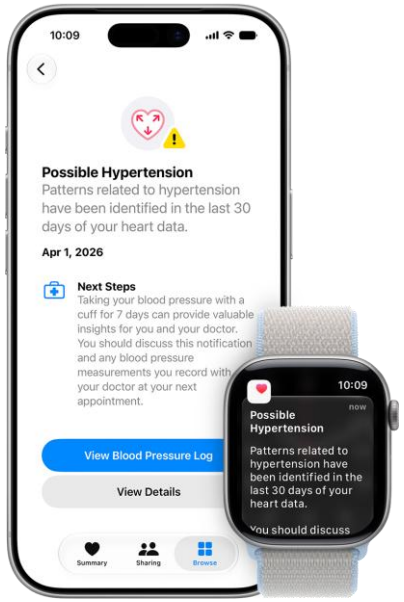
2025 Apple Watch alerts
Flags possible hypertension; no BP numbers



Biobeat patch



Hilo Band

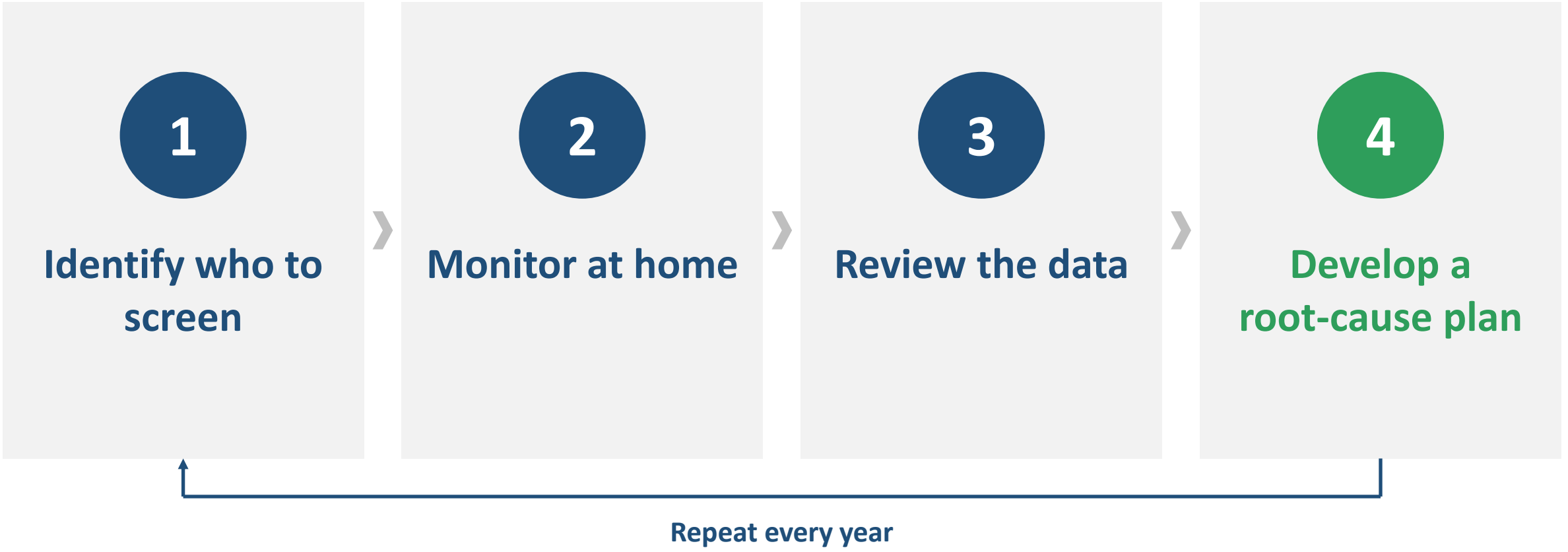


Apple Watch

FDA 510(k): Biobeat, Aug 2019; Hilo (Aktiia), Jul 2025; Apple hypertension notifications, Sep 2025. · Images: Biobeat, Hilo, Apple.

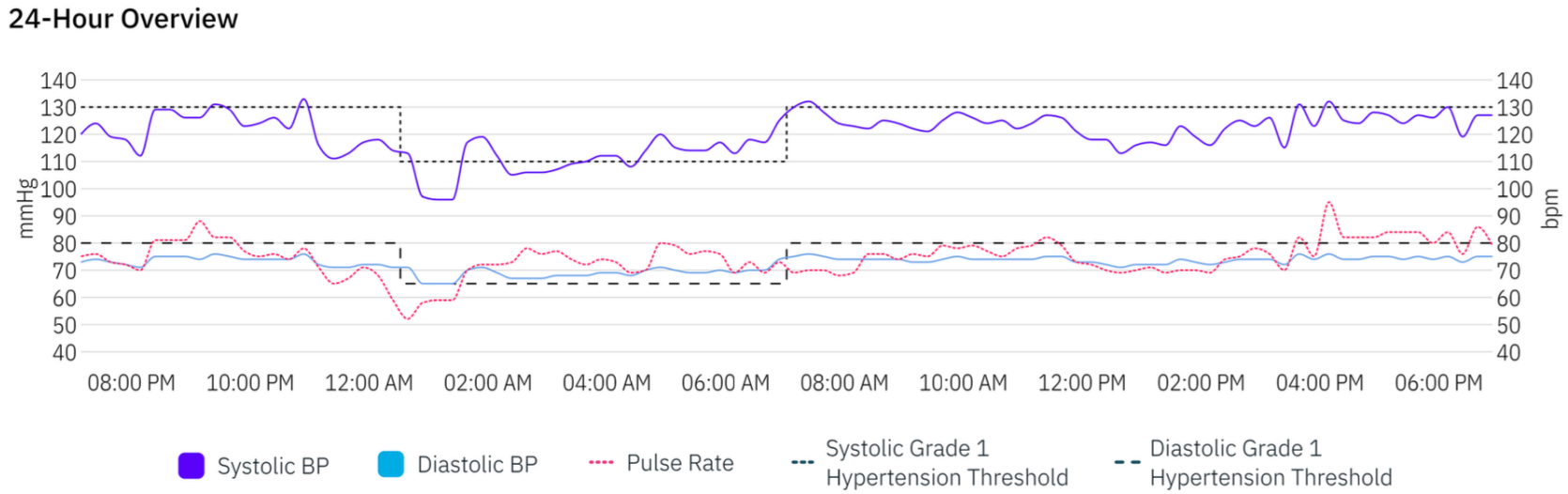
Yearly 24-Hour BP Screening in Naturopathic Practice

Whole-person care deserves whole-picture data



Proposed model. Built on: USPSTF, JAMA 2021;325:1650–1656 (out-of-office confirmation) · Jones DW, et al. J Am Coll Cardiol 2025;86:1567–1678 · Shimbo D, et al. Circulation 2020;142:e42–e63 (annual out-of-office monitoring for white-coat and elevated BP).

Case 1: A Normal 24-Hour Pattern



What we see

- Daytime BP ~125/75, under 130/80
- BP falls ~10% in sleep, rises on waking
- Pulse slows at night

What it may mean

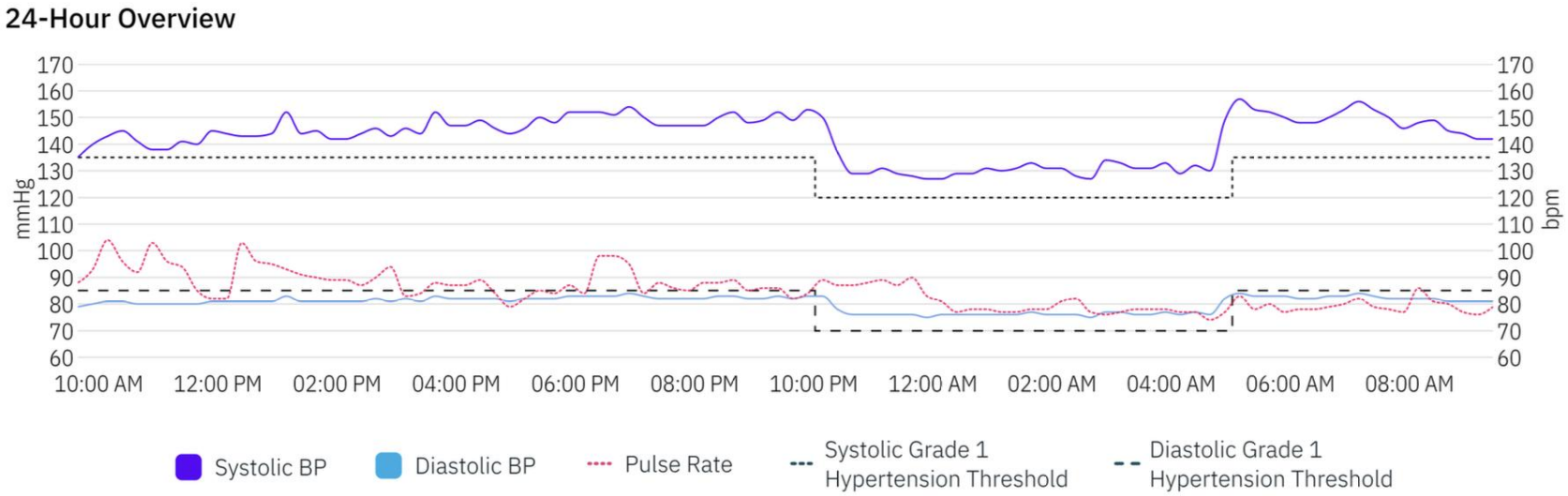
- Healthy level and healthy rhythm
- The body's balance is working
- A personal baseline for future years

Root-cause plan

- Keep the habits that are working
- Repeat the 24-hour screen next year

De-identified 24-hour ambulatory BP report. Dashed lines: grade 1 hypertension thresholds (daytime 130/80, nighttime 110/65).

Case 2: Hypertension With Normal Dipping



What we see

- BP falls ~10% in sleep, rises on waking
- Pulse slows at night: healthy rhythm
- But systolic runs ~145 by day, ~130 at night

What it may mean

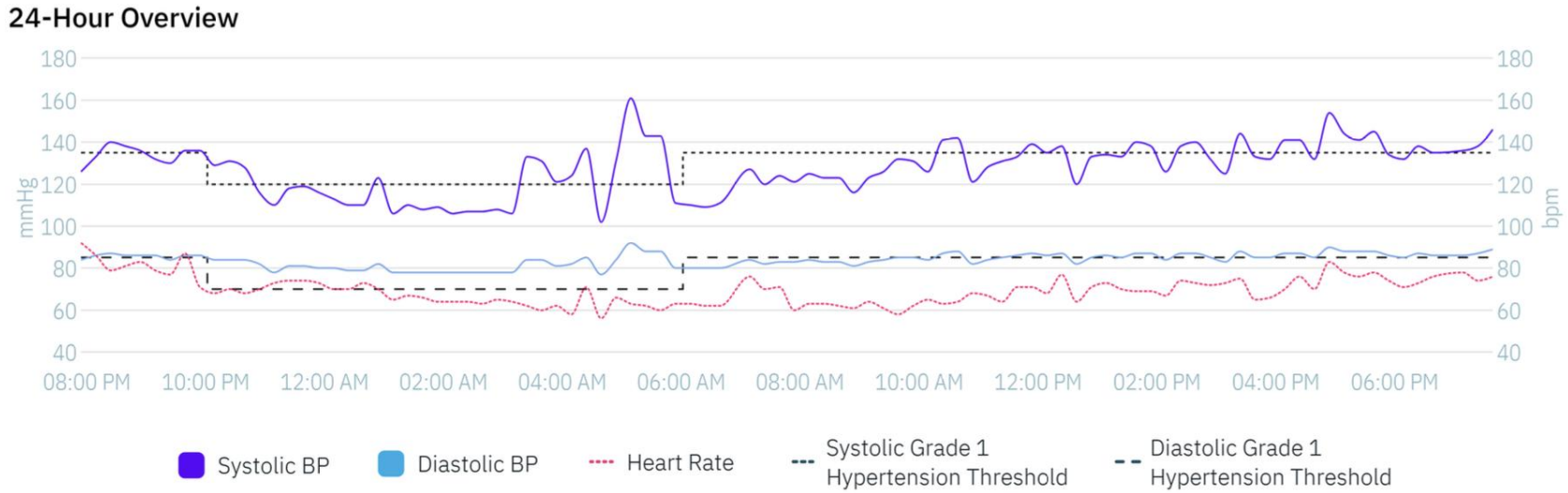
- The body's daily rhythm is intact
- The level is the problem: hypertension
- A clear target for lifestyle change

Root-cause plan

- Salt, movement, weight, alcohol, sleep
- Home readings to track progress
- Recheck in 3–6 months; co-manage if not at goal

De-identified 24-hour ambulatory BP report. Dashed lines: grade 1 hypertension thresholds (daytime 135/85, nighttime 120/70).

Case 3: Possible Sleep Apnea



What we see

- Sharp BP surges during sleep, up to ~160 near 5 AM
- Nighttime diastolic stays ~80, above the 70 limit
- Daytime BP often above 135/85

What it may mean

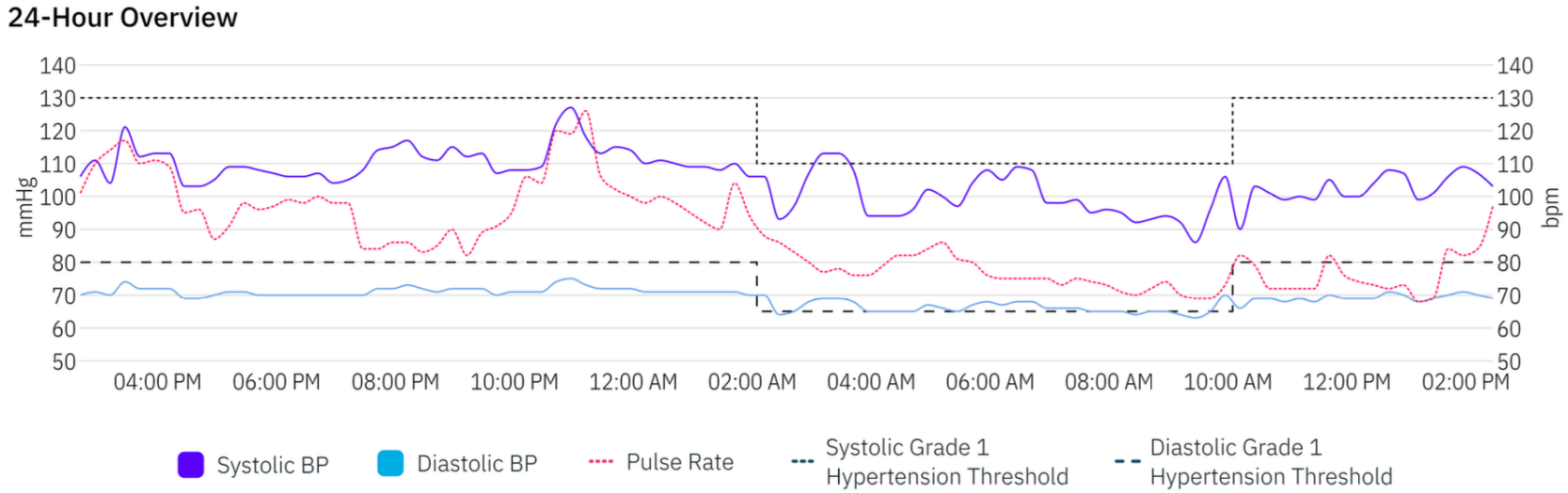
- Night surges fit breathing pauses in sleep
- Nighttime hypertension: a strong stroke risk signal
- Sleep apnea can raise daytime BP too

Root-cause plan

- Ask about snoring, pauses, daytime sleepiness
- Home sleep test; coordinate with physician
- Weight, alcohol, side-sleeping; recheck BP

De-identified 24-hour ambulatory BP report. Dashed lines: grade 1 hypertension thresholds (daytime 135/85, nighttime 120/70).

Case 4: ME/CFS, When the Problem Isn’t High BP



What we see

- Low-normal BP all 24 hours
- Fast evening pulse, spiking near 125
- Late sleep (~2–10 AM); BP ~87 on waking

What it may mean

- Not hypertension
- Fast pulse + low BP: possible orthostatic intolerance
- Low BP on rising may worsen morning fatigue

Root-cause plan

- Check lying and standing BP and pulse
- Fluids, salt, compression; pacing
- Sleep timing; coordinate with physician

De-identified 24-hour ambulatory BP report. Dashed lines: grade 1 hypertension thresholds (daytime 130/80, nighttime 110/65).

High blood pressure is a silent risk in 50% of adults

Screening is our responsibility

Prevention is what we do best

“When prevention works, nothing happens.”

Thank you

drcharles@smartshealth.net

Scan to email me