AUTHOR

Teemu J. Niiranen, Renate B. Schnabel, Aletta E. Schutte, Yitschak Biton, Giuseppe Boriani, Claire Buckley, Alan C. Cameron, Albertino Damasceno, Søren Z. Diederichsen, Wolfram Doehner, Yutao Guo, F.D. Richard Hobbs, Boyoung Joung, Graeme J. Hankey, Gregory Y.H. Lip, Trudie Lobban, Maja-Lisa Løchen, Georges Mairesse, Amam Mbakwem, Peter A. Noseworthy, George Ntaios, Steven Steinhubl, George Stergiou, Jesper Hastrup Svendsen, Robert G. Tieleman, Jiguang Wang, Neil R. Poulter, Jeff S. Healey, and Ben Freedman

TITLE

Hypertension and Atrial Fibrillation: A Frontier Review From the AF-SCREEN International Collaboration

YEAR

2025

DOI

https://doi.org/10.1161/CIRCULATIONAHA.124.071047

VERSION

Author's accepted manuscript

CITATION

Teemu J. Niiranen, Renate B. Schnabel, Aletta E. Schutte, Yitschak Biton, Giuseppe Boriani, Claire Buckley, Alan C. Cameron, Albertino Damasceno, Søren Z. Diederichsen, Wolfram Doehner, Yutao Guo, F.D. Richard Hobbs, Boyoung Joung, Graeme J. Hankey, Gregory Y.H. Lip, Trudie Lobban, Maja-Lisa Løchen, Georges Mairesse, Amam Mbakwem, Peter A. Noseworthy, George Ntaios, Steven Steinhubl, George Stergiou, Jesper Hastrup Svendsen, Robert G. Tieleman, Jiguang Wang, Neil R. Poulter, Jeff S. Healey, and Ben Freedman 2025, Hypertension and Atrial Fibrillation: A Frontier Review From the AF-SCREEN International Collaboration. Circulation vol 151 (12), pp. 863–877. DOI: 10.1161/CIRCULATIONAHA.124.071047

Hypertension and Atrial Fibrillation:

A Frontier Review from the AF-SCREEN International Collaboration

Teemu J. Niiranen MD PhD,[1,2,3] Renate Schnabel MD MSc,[4,5] Aletta E. Schutte PhD,[6,7] Yitschak Biton MD,[8] Giuseppe Boriani MD,[9] Claire Buckley MD,[10] Alan Cameron MD PhD,[11] Albertino Damasceno MD PhD,[12] Søren Z. Diederichsen MD PhD,[13] Wolfram Doehner MD PhD,[14,15,16,17] Yutao Guo MD,[18] F.D. Richard Hobbs MD,[19] Boyoung Joung MD PhD,[20] Graeme J. Hankey MD,[21,22] Gregory Y.H. Lip MD,[23,24] Trudie Lobban MBE,[25,26] Maja-Lisa Løchen MD PhD,[27,28] Georges Mairesse MD,[29] Amam Mbakwem MBBS,[30] Peter A. Noseworthy MD MBA,[31] George Ntaios MD MSc,[32] Steven Steinhubl MD,[33] George Stergiou MD,[34] Jesper Hastrup Svendsen MD DMSc,[13,35] Robert G. Tieleman MD PhD,[36] Jiguang Wang MD PhD,[37] Neil R. Poulter MBBS MSc,[38] Jeff S. Healey MD MSc[39] and Ben Freedman MBBS PhD[40]

Running title: Hypertension and atrial fibrillation

Corresponding Author: Teemu J Niiranen, Department of Internal Medicine, University of Turku, P.O. Box 52, 20521 Turku, Finland; e-mail: teemu.niiranen@utu.fi; telephone: +358 50 3306863

Word Count Text: 4,494 words

Affiliations:

1. Department of Internal Medicine, University of Turku, Turku, Finland

2.Division of Medicine, Turku University Hospital, Turku, Finland

3.Department of Public Health and Welfare, Finnish Institute of Health and Welfare, Turku, Finland

4. Department of Cardiology, University Heart & Vascular Center Hamburg, University Medical Center Hamburg-Eppendorf, Hamburg, Germany

5. German Center for Cardiovascular Research (DZHK) partner site Hamburg/Kiel/Lübeck, Germany
6. School of Population Health, University of New South Wales, Sydney, NSW, Australia
7. The George Institute for Global Health, Sydney, NSW, Australia
8. Heart Institute, Hadassah Medical Organization and Faculty of Medicine, Hebrew University of Jerusalem, Jerusalem, Israel
9. Cardiology Division, Department of Biomedical, Metabolic and Neural Sciences, University of Modena and Reggio Emilia, Policlinico di Modena, Modena, Italy
10. School of Public Health, University College Cork, Cork Ireland
11. School of Cardiovascular and Metabolic Health, University of Glasgow, Glasgow, UK
12. Faculty of Medicine, Eduardo Mondlane University, Maputo, Mozambique
13. Department of Cardiology, Copenhagen University Hospital - Rigshospitalet, Copenhagen, Denmark
14. Berlin Institute of Health Center for Regenerative Therapies, Charité - Universitätsmedizin Berlin, Berlin, Germany
15. German Heart Center of the Charité-Universitätsmedizin Berlin, Germany
16. Center for Stroke Research Berlin, Charité - Universitätsmedizin Berlin, Berlin, Germany
17. German Centre for Cardiovascular Research (DZHK), Partner Site Berlin, Germany
18. Pulmonary Vessel and Thrombotic Disease, Sixth Medical Center, Chinese PLA General Hospital, Beijing, China
19. Nuffield Department of Primary Care Health Sciences, University of Oxford, UK
20. Department of Internal Medicine, Yonsei University, Seoul, South Korea
21. Perron Institute for Neurological and Translational Science, Perth, Australia
22. Centre for Neuromuscular and Neurological Disorders, Medical School, The University of Western Australia, Perth, Australia
23. Liverpool Centre for Cardiovascular Science at University of Liverpool, Liverpool John Moores University and Liverpool Heart & Chest Hospital, Liverpool, UK

24. Danish Center for Health Services Research, Department of Clinical Medicine, Aalborg University, Aalborg, Denmark
25. Arrhythmia Alliance, Stratford Upon Avon, Warwickshire, UK
26. AF Association, Hilton Head Island, SC, USA
27. Department of Clinical Medicine, UiT The Arctic University of Norway, Tromsø, Norway
28. Department of Cardiology, University Hospital of North Norway, Tromsø, Norway
29. Department of Cardiology, Cliniques du Sud Luxembourg, Arlon, Belgium
30. Department of Medicine, College of Medicine, University of Lagos, idi Araba, Nigeria
31. Department of Cardiovascular Diseases, Mayo Clinic, Rochester, MN, USA
32. Department of Internal Medicine, School of Health Sciences, Faculty of Medicine, University of Thessaly, Larissa, Greece
33. Weldon School of Biomedical Engineering, Purdue University, West Lafayette, Indiana, USA
34. Hypertension Center STRIDE-7, National and Kapodistrian University of Athens, School of Medicine, Third Department of Medicine, Sotiria Hospital, Athens, Greece
35. Department of Clinical Medicine, University of Copenhagen, Copenhagen, Denmark
36. Department of Cardiology, Martini Hospital Groningen, Groningen, The Netherlands
37. Department of Cardiovascular Medicine, Centre for Epidemiological Studies and Clinical Trials, State Key Laboratory of Medical Genomics, Shanghai Key Laboratory of Hypertension, Department of Hypertension, The Shanghai Institute of Hypertension, Ruijin Hospital, Shanghai Jiaotong University School of Medicine, Shanghai, China
38. School of Public Health, Imperial College London, London, UK
39. Population Health Research Institute, McMaster University, Hamilton, Ontario, Canada
40. Heart Research Institute, Charles Perkins Center, and Cardiology Department, Concord Hospital, The University of Sydney, Sydney, Australia.

Abstract

Hypertension is the leading modifiable risk factor for atrial fibrillation (AF) and is estimated to be present in >70% of AF patients. This Frontiers Review was prepared by 29 expert members of AF-SCREEN International Collaboration to summarize existing evidence and knowledge gaps on links between hypertension, AF, and their cardiovascular sequelae; simultaneous screening for hypertension and AF; and the prevention of AF through antihypertensive therapy. Hypertension and AF are inextricably connected. Both are easily diagnosed, often silent, and frequently inadequately treated. Together, they additively increase the risk of ischemic stroke, heart failure, and many types of dementia, resulting in greater all-cause mortality, considerable disease burden and increased healthcare expenditures. Automated upper arm cuff blood pressure devices with implemented technology can be used to simultaneously detect both hypertension and AF. However, positive screening for AF with an oscillometric BP monitor still requires ECG confirmation. The current evidence suggests that high-risk individuals aged ≥65 years or with treatment-resistant hypertension could benefit from AF screening. Since antihypertensive therapy effectively lowers AF risk, particularly in individuals with left ventricular dysfunction, hypertension should be the key target for AF prediction and prevention, rather than merely a co-morbidity of AF. Nevertheless, several important gaps in knowledge need to be filled over the next years, including the ideal method and selection of patients for simultaneous screening of hypertension and AF; and the optimal antihypertensive drug class and blood pressure targets for AF prevention.

Key words: Hypertension, atrial fibrillation, screening, prevention

Non-standard Abbreviations and Acronyms

ACE, angiotensin-converting enzyme

ACCORD-BP, Action to Control Cardiovascular Risk in Diabetes-Blood Pressure

AF, atrial fibrillation

ALLHAT, Antihypertensive and Lipid-Lowering Treatment to Prevent Heart Attack Trial

ARB, angiotensin-receptor blocker

BP, blood Pressure

CAPPP, Captopril Prevention Project

CI, confidence interval

CVD, cardiovascular disease

DANCAVAS, Danish Cardiovascular Screening

LIFE, Losartan Intervention for Endpoint Reduction

LOOP, Implantable Loop Recorder Detection of Atrial Fibrillation to Prevent Stroke

MMM, May Measurement Month

MR, mineralocorticoid receptor

OR, odds ratio

SAFER, Screening for Atrial Fibrillation with ECG to Reduce Stroke

SHEP, Systolic Hypertension in the Elderly Program

PRINT, Systolic Blood Pressure Intervention Trial

STOP-Hypertension-2, Second Swedish Trial in Old Patients with Hypertension

STROKESTOP, Clinical Outcomes in Systematic Screening for Atrial Fibrillation

VALUE, Valsartan Antihypertensive Long-term Use Evaluation

Highlight Section – Key Points

1. Hypertension is the leading modifiable risk factor for both AF and stroke.
2. More focus should be placed on hypertension for prediction and prevention of AF, rather than merely as a co-morbidity of AF.
3. Hypertension, AF, heart failure, stroke, and many types of dementia are part of a CVD continuum.
4. Positive screening for AF with an oscillometric BP monitor requires ECG confirmation.
5. High-risk individuals aged ≥65 years or with treatment-resistant hypertension could benefit from AF screening.
6. Antihypertensive therapy can effectively lower the risk of developing AF, particularly in patients with left ventricular dysfunction.
7. Inconsistency in the randomized controlled trial data linking BP-lowering with reduced AF risk likely results from differential effects of BP-lowering agents on AF risk.

Introduction

Hypertension is the leading modifiable risk factor for global burden of disease and the most prevalent cardiovascular disease (CVD) risk factor, affecting approximately one third of the population worldwide.[1] It is also the strongest modifiable risk factor for development of atrial fibrillation (AF), the most common sustained arrythmia with an 0.5% worldwide prevalence.[2] In addition to being strongly correlated, the prevalence of both increase with age, and they additively increase the risk of stroke, heart failure, and dementia, resulting in greater all-cause mortality.[3] Hypertension and AF are often silent, and even when known, are frequently inadequately treated, leading to excess preventable cardiovascular mortality and morbidity.

The AF-SCREEN International Collaboration was founded in 2015 to promote discussion and research about screening for unknown or under-treated AF to reduce stroke and death (www.afscreen.org). It includes well over 200 physicians, nurses, allied health professionals, epidemiologists, health economists, and patient group representatives from over 40 countries. May Measurement Month (MMM, www.maymeasure.org) was formed to highlight the importance of measuring blood pressure (BP) globally and the risks of hypertension.[4] In 2022, MMM and AF-SCREEN joined forces to search for unknown and undertreated hypertension and AF, with leaders of MMM becoming AF-SCREEN members.

This Frontiers Review was prepared by 29 expert members of AF-SCREEN including MMM leads, to summarize current knowledge of the relationship between hypertension, AF, and their adverse outcomes. Key points were determined using a Delphi process and retained if agreement was ≥85% amongst responding AF-SCREEN members (**Supplemental Material**).

177

Epidemiologic Links Between Hypertension, AF, and Adverse Outcomes

Global Burden and Costs

The global burden of hypertension and AF is rising rapidly, particularly in low- and middle-income countries where the levels of hypertension awareness, treatment, and control are often the lowest.[1,3] Although data from sub-Saharan Africa are scarce, the relation of social development with age-standardized AF-related incidence, disease burden, and mortality appears to be inverse, highlighting the need for improved resources, patient education and health literacy.[2,5] However, as the absolute prevalence of AF is still lower in low- compared to high-income countries, most of its disease burden continues to arise from developed countries.

AF and hypertension have significant costs to societies. Although the global mean BP appears to be currently stable, the financial burden of hypertension is approximately 10% of the world's overall healthcare expenditures.[6] This estimate also includes indirect costs resulting from premature mortality and disability due to sequelae, such as stroke and AF.[6] For AF, extrapolating data from the trends observed in the past 20 years suggests that the increasing prevalence of AF could lead to >10 million disability-adjusted life-years and nearly half a million deaths by the year 2050.[3]

Hypertension as an AF Risk Factor

Haemodynamic changes, neuroendocrine factors, atrial and ventricular structural remodelling including myocardial fibrosis, and a proarrhythmogenic electrophysiologic phenotype of a hypertrophic left ventricle, all contribute to the complex pathophysiology of arrhythmogenesis in hypertension (**Figure 1**).[7] Indeed, AF could be regarded as a manifestation of hypertensive target-organ damage.

Due to its high prevalence of 33% in the general adult population, hypertension is the most modifiable significant population-attributable risk factor for AF and is estimated to be present in >70% of AF patients and responsible for up to 39% of all AF cases **(Key Point 1, see Highlight Section)**. [2,8] A pooled risk estimate revealed a 73% greater likelihood of AF in patients with hypertension (odds ratio [OR] 1.73%; 95% confidence Interval [CI], 1.31–2.28) compared to non-hypertensive individuals, and this risk was even greater in the presence of left ventricular hypertrophy. [9] This risk increase starts already at low BP levels as prehypertension is also independently associated with AF. [10] Individuals with treatment-resistant hypertension have the greatest relative risk for AF, with an OR of 2.95 for controlled resistant hypertension and 2.47 for uncontrolled resistant hypertension. [11] Moreover, hypertension has also been identified as an independent risk factor for AF progression, [12] AF-related stroke and mortality, [13] and anticoagulant-related bleeding complications in AF. [14] Results from recent observational studies on the association between hypertension and AF are presented in **Table 1**.

A population group of specific concern is the elderly, especially considering that AF prevalence increases with age. In previous prospective studies in healthy women[15] and middle-aged men, [16] the relationship between BP levels and new onset AF has been linear, even in people with a high-normal BP (130–139/85–89 mmHg). [15,16] However, this association attenuates with age, and a recent study demonstrated that in the older population a linear increase in systolic BP was not independently associated with increased AF risk, and only exposure to BP ≥160/100 mmHg carried a higher risk of AF. [19,20]

Observational studies have reported that higher BP is strongly associated with greater risk of incident AF, but this relationship might be confounded by antihypertensive therapy and co-existent risk factors. However, a large Mendelian randomization identified relationships between AF and systolic BP (OR, 1.018 per 1 mmHg increase; 95% CI, 1.012–1.024), and

diastolic BP (OR, 1.026; 95% CI, 1.016–1.035), strongly suggesting that these associations are causal.[21]

A common reason for resistant hypertension may be primary aldosteronism, which can be overlooked as a cause of both hypertension and AF.[22] A history of AF was detected in 7.3% of patients with primary aldosteronism and 0.6% of patients with essential hypertension (OR, 12.1; 95% CI, 3.2–45.2).[23] The optimal therapy of primary aldosteronism for AF prevention remains unclear. In two observational studies, mineralocorticoid receptor (MR) therapy has been shown to result in a substantially greater AF risk compared to surgical adrenalectomy.[24,25] However, this could be a sign of insufficient MR blockade as MR antagonist therapy has been shown to result in a 2.5-fold higher risk for AF compared to patients with essential hypertension when their renin remained suppressed.[24] In contrast, this risk was not increased in patients whose renin increased with MR antagonist therapy or who underwent surgical adrenalectomy.[24] A wide range of hypertensive patients, and particularly those with drug-resistant hypertension and lone AF, should be tested for primary aldosteronism.[22]

High sodium consumption is considered to be a leading dietary risk factor for hypertension and CVD worldwide.[26] A recent trial also demonstrated that replacing regular salt with a potassium-enriched salt substitute resulted in lower rates of hypertension, stroke, CVD events, and death.[27] Although a single prospective study has suggested that high dietary sodium intake may independently increase the risk for AF, the relation between sodium and potassium intake and new-onset AF remains unclear.[28,29]

Observational and Mendelian randomization studies consistently support the association between optimal BP and a reduced AF burden. Hypertension is the most important modifiable AF risk factor, and more focus should therefore be placed on it for AF prediction

and prevention instead of merely for comorbidity therapy in overt AF **(Key Point 2, see Highlight Section)**.

Hypertension and AF as Stroke Risk Factors

The strong links between hypertension, AF and stroke are evident in the subgroup of AF patients who have had an ischemic stroke. In large pivotal trials of direct oral anticoagulants in this group, 77–86% of patients with a prior stroke also had a history of hypertension. [30] Similar results have also been reported in observational studies of patients with previous stroke, [31,32] and this association shows an increasing temporal trend. Moreover, stroke patients with permanent AF have higher rates of arterial hypertension compared to patients with paroxysmal or persistent AF. [33]

Ischemic stroke has many causes, [34] with hypertension and AF among the most important aetiologies accounting for several mutually augmenting mechanisms to trigger a stroke (**Figure 1**). Arterial hypertension can cause stroke through several direct and indirect pathophysiologic mechanisms including cerebral artery damage (small-artery disease) leading to lacunar strokes, promotion of large artery atherosclerosis, and left atrial/ventricular disease (accounting for cardioembolic strokes). [35] Hypertension via cerebral vascular injury accounts for white matter lesions and silent brain infarcts. AF in turn leads mostly to cardioembolic strokes. However, given the tight interrelation between AF and hypertension, the presence of AF with the comorbidity of arterial hypertension and ischemic stroke does not necessarily indicate that stroke in a patient with AF is cardioembolic. [34]

Hypertension, AF, and Heart Failure as Co-Existing Risk Factors for Stroke and Dementia

Hypertension, AF, heart failure, stroke, and dementia are all part of a continuum of CVD (**Figure 1**). Among individuals with hypertension, the lifetime risk of heart failure is 7.8%, which is 1.5 times higher than in people without hypertension. [36] Persistent midlife hypertension is also associated with an 1.4–1.6-fold risk of late-life dementia. [37,38] AF and

heart failure account for approximately 10–20% of the population attributable risk of all stroke, which in turn doubles the risk of dementia.[39,40] In addition to acute brain damage, this stroke-related increase in dementia risk is also considered to be a result of ongoing cerebrovascular injury due to vascular risk factors, immune processes, and pathogenic mechanisms may contribute to dementia risk after stroke,[41] but dementia and AF are strongly related even in the absence of stroke.[42]

AF, hypertension, and heart failure individually increase the risk of incident stroke by about 1.5-fold, and, together they more than double stroke risk.[43] Prior stroke in turn is also a major cause of cognitive impairment and dementia, with an incidence rate of 22% in 4 years after stroke.[41] In the prevention of symptomatic overt CVD, AF and dementia, treatment of hypertension should therefore be prioritized as it usually lies at the beginning of this unfavorable process (**Figure 1; Key Point 3, see Highlight Section**).

Screening for Hypertension and AF

Screening for Hypertension and AF in Primary Care

Health systems currently have different approaches to detect stroke risk factors in primary care. In the United Kingdom, the National Health Service offers a Health Check to people aged 40 to 74, which includes assessment for hypertension and AF amongst other conditions.[44] A similar Chronic Disease Prevention Programme is available in Ireland for people aged over 45 years.[45] In China, systematic AF screening with ECG is recommended in the population aged over 70 years.[46] The World Heart Federation 2021 Roadmaps recommend opportunistic screening for AF with pulse check or ECG in people >65 years, and for hypertension in people >18 years.[47,48]

Methods for AF detection include pulse palpation, handheld or 12-lead ECG, and the use of newly emerging technologies with AF-detecting algorithms implemented in wearables (smart-watches, fit-bands, rings), or in automated electronic cuff BP monitors (**Figure 2**). ECG-equipped BP monitors have also been recently introduced to the market.[49,50] Once standardized, quality-assured mechanisms for measurement and interpretation of findings are implemented, this assessment can take place in several sites in primary care including the general practitioner's surgery, pharmacy, community centre or the person's home. The ideal location will likely vary across health systems due to a variety of cultural and healthcare system infrastructural reasons, but primary care may usually be the most convenient and appropriate site for detecting AF.

Prior to embarking on any stroke prevention initiative in primary care, consideration should be given to potential harms or unintended consequences. Care must be taken to minimize excessive worry or concern amongst patients in the process. Consideration should also be given to the cost of such initiatives and the capacity to deliver screening. Cost-benefit analyses are required to ensure optimal use of primary care resources. Feasibility of

implementation in the constraints of available resources will be determined locally. Finally, if screening for hypertension and AF is to take place in primary care, consideration should also be given to searching for other risk factors for stroke such as smoking, diabetes, and dyslipidemia.

Simultaneous Screening of Hypertension and AF – Data from Observational Studies

AF and hypertension often co-exist, both are frequently unknown, and early detection and treatment may prevent serious complications, especially in those with co-existing conditions. Therefore, it is reasonable to screen for both conditions in one setting. This approach may be both efficient and economical, possibly also leading to improved adherence to treatment.

Technological advances facilitate combined screening by algorithms specific for AF detection embedded in automated cuff BP measuring devices (**Figure 2**).[51] The first study that validated such an algorithm for AF detection during routine automated BP measurement vs standard 12-lead ECG was published in 2004.[52] The AF detection algorithm estimated an "irregularity index", which was calculated using the standard deviation and the mean of time intervals between successive pulse beats.[52] In the last decade, further studies were published using similar algorithms and confirmed their high diagnostic value for AF detection and their clinical potential.[53] AF detection during automated office BP measurement has been shown to be more accurate than pulse palpation during medical visits, and has comparable accuracy to single lead ECG.[54] AF detecting algorithms have also been implemented in devices designed for 24-hour ambulatory BP monitoring with encouraging results (**Figure 2**).[55] Photoplethysmography-based (wearable) devices for detection of BP and AF are also available, but their BP measurement function remains experimental and requires calibration with a cuff-based device (**Figure 2**).[56] If AF is detected by such devices, an ECG recording is needed to confirm AF diagnosis before treatment decisions **(Key Point 4, see Highlight Section)**.[54] This additional step, however, could be avoided by using a BP

monitor with an ECG recording option, [49,50] or use of a handheld or wearable ECG device to record a simultaneous ECG rhythm strip.

Observational studies of AF screening during automated BP measurement are divided in two categories: (i) validation studies which applied a reference method (mostly simultaneous ECG) in all participants aiming at evaluating accuracy of the AF detecting algorithms, and (ii) population studies without a reference method, or with a reference method applied only in participants at high AF risk or with AF detected by the BP device algorithm. Examples of recent and observational studies are shown in **Table 2.** Recent meta-analyses of validation studies assessing automated BP monitors with AF detecting algorithms indicate a high diagnostic accuracy with a pooled sensitivity and specificity of 95% and 94%, respectively. [53] However, the positive and negative predictive values depend on the prevalence of AF in the population screened and are relatively low in young and healthy populations. Thus, most population studies have been conducted in individuals aged ≥65 years in whom screening for AF is primarily indicated (**Table 2**). Interestingly, the prevalence of AF indicated by BP devices is in line with the prevalence of AF derived by epidemiologic data and traditional screening methods in similar populations. [54,60]

Community-based BP and AF screening campaigns are also ongoing. In 2023, The MMM AF screening sub-study combined population screening for hypertension with screening for AF, using automated OMRON Complete cuff BP monitors (ECG based) and Omron M7 (AF detecting algorithm based) on participants aged >60 years in 19 participating countries. Those with detected AF were referred to relevant medical facilities to confirm AF diagnosis and initiate management as required. Data regarding treatment and follow-up of those patients detected with AF have been collected and are being analyzed as part of this sub-study. [4]

Other point Automated upper arm cuff BP devices with implemented technology can be used to simultaneously detect both hypertension and AF with high sensitivity and specificity.

Simultaneous Detection of Hypertension and AF – Results from Randomized Trials

Only the Danish Cardiovascular Screening (DANCAVAS) randomized controlled trial has studied combined hypertension and AF screening (**Table 3**). [6]DANCAVAS was population-based and included males aged 65-74 years. Participants were randomized 1:2 to screening or no screening (control group). Among several modalities, screening involved standard BP measurement and a computed tomography scan to assess coronary artery calcification score during which a 10-second ECG recording was made. Suspected hypertension, defined as BP ≥160/100 mmHg during screening, was found in 9% of the participants whereas AF was observed in only 0.5%, reflecting the very short monitoring period and the relatively young participants.

Optimal Selection of Individuals for Simultaneous Screening of AF and Hypertension

Currently, guidelines recommend different approaches for AF opportunistic screening and the role of hypertension remains mostly unclear. The American Heart Association and the American Stroke Association state that case finding for AF in the primary care setting among persons older than 65 years using pulse assessment followed by ECG can be useful. [68] In contrast, the American Academy of Family Physicians supports the US Preventive Services Taskforce, which concluded that current evidence is insufficient to assess the balance of benefits and harms of AF screening, though “opportunistic screening” is regarded as case-finding rather than screening. [69] The 2023 joint American College of Cardiology/American Heart Association guidelines provide no recommendations on AF screening, and state there are no outcome studies of strategies for selection based on risk models. [70] The 2024 European Society of Cardiology guidelines still recommend opportunistic screening in patients age >65 years by single-lead ECG devices. [54]

Randomized and nonrandomized studies investigating AF screening often report that hypertension is more prevalent in people with AF detected by screening.[71] In the Implantable Loop Recorder Detection of Atrial Fibrillation to Prevent Stroke (LOOP) trial, hypertension prevalence was around 90%, and screening reduced risk of stroke in people with baseline systolic BP >150 mmHg despite no difference in BP management between screened vs unscreened participants.[72] Hypertension and higher systolic BP were associated with higher AF burden,[73] although not screening yield.[74] In the Clinical Outcomes in Systematic Screening for Atrial Fibrillation (STROKESTOP) trial, only 35% of participants had hypertension at baseline,[64] which could partly explain the signal of a missed opportunity for stroke prevention. By contrast, the Detecting and Diagnosing Atrial Fibrillation (D2AF) trial found that screening uptake was higher among invitees with hypertension than without;[75] and both STROKESTOP and its successor STROKESTOP II reported higher yield of AF screening in participants with hypertension compared to those without hypertension.[64,76]

AF risk scores could help target population screening and most scores include hypertension. Blood, ECG, genetic, and echocardiography biomarkers could also help target screening. Natriuretic peptides are among the most promising blood markers and improve classification when added to conventional risk factors.[77,78] More novel AF risk factors are less readily available in primary care or low-resource settings so implementation should therefore focus on clinical risk factors, such as hypertension, and widely available biomarkers like natriuretic peptides and ECG measurements.

The age-based selection of hypertensive individuals for AF screening is complicated by the fact that the association between hypertension and AF attenuates with age.[19,20] Until further data are available (see 'Conclusions and future directions') , simultaneous screening could be recommended for those with the greatest relative AF risk, i.e. individuals with treatment-resistant hypertension **(Key Point 5, see Highlight Section)**.[11] Our AF-SCREEN

International Collaboration highlights that large randomized controlled trials are necessary to generate evidence of AF screening on stroke reduction[79]: ongoing studies addressing this include the Screening for Atrial Fibrillation with ECG to Reduce Stroke (SAFER) [80] (ISRCTN16939438) and Heartline (NCT04276441) trials.

Patient and Consumer Experience on Simultaneous Screening of Hypertension and AF

Because it is possible to screen and monitor both BP and AF at home simultaneously, [53,81] without the need for a health care interaction, the barriers to doing so are much lower than for almost any other combination of health conditions. While the tools necessary to screen AF and BP at home have been available for some time, availability in some countries remains limited, but is rapidly growing. Although most of the world population lack means for BP screening, a recent survey found that half of American adults between age 50–80 with hypertension self-monitor BP. [82] Self-monitoring heart rhythm using an ECG is also becoming more common with increasing use of personal ECG devices (e.g. Kardia) and ECG-capable smartwatches.

The willingness for an individual to self-monitor will vary based on many factors – costs, relationship and recommendations from their healthcare provider, and self-activation. A recent survey of just under 900 individuals from the AF Association, who are certainly more likely to manage their CVD health than a random population sample, found that 87% use a home BP monitor and 77% also have a device at home to measure their heart rate and rhythm, with half of those being ECG-based (**Table 4**). Just over half of these devices had the ability to alert the user to an irregular rhythm or AF specifically. A little under half of survey respondents reported use at least weekly with 36% doing so daily.

However, there are user-centric challenges that need to be recognized when implementing any home-based dual-screening program. While there is clearly a small sub-population of individuals who are comfortable with, and even motivated to track their health data, there is

also an important portion of the population who see self-tracking as a reminder that they are a “sick person”. [83] For example, a randomized trial of home monitoring of BP plus selfcare support that found that while selfcare support did reduce BP relative to home monitoring alone, self-care support was also found to worsen depression. [84] Existing limited data support that there is no “one size fits all” screening strategy for hypertension and AF. What is empowering for one person may worsen psychological health for another.

BP Lowering for Prevention of AF

Findings from epidemiological studies suggest that aggressive BP control may reduce the risk of new-onset AF. In observational studies, a dose-response relationship has been noted between the achieved BP level and new-onset AF.[85,86] In the Losartan Intervention for Endpoint Reduction (LIFE) trial, compared to achieved systolic BP ≥142 mmHg, tighter systolic BP control ≤130 mm Hg was associated with a 40% lower new-onset AF risk, and systolic BP 131–141 mmHg was associated with 24% lower risk.[85] Another population-based case-control study performed in a US health delivery system included 433 patients on antihypertensive therapy with verified new-onset AF and 899 controls.[86] In this study, compared with the reference level of 120–129 mmHg, for categories of average achieved systolic BP 130-139, 140-149, 150-159, 160-169 and ≥170 mm Hg, the ORs for incident AF were 1.19, 1.40, 2.02, 2.27 and 1.84, respectively.[86] Surprisingly, an achieved systolic BP <120 mmHg was associated with increased AF risk (OR, 1.99). These observational findings underscore the importance of effective BP management in prevention of AF. Due to the inherent limitations of observational studies, randomized controlled trials would provide more compelling evidence of a causal relationship between BP control and AF incidence or burden.

Outcomes from trials of more versus less intensive antihypertensive therapy for AF prevention have also been mixed until recently. The Systolic Hypertension in the Elderly Program (SHEP) and Action to Control Cardiovascular Risk in Diabetes-Blood Pressure (ACCORD-BP) trials failed to individually demonstrate a statistically significant reduction in AF for more versus less intensive antihypertensive therapy.[87,88] However, in a meta-analysis of three trials (Systolic Blood Pressure Intervention Trial [SPRINT], SHEP, and ACCORD-BP), more intensive therapy was associated with a 20-23% lower risk of incident AF.[89] Furthermore, in the Cardio-Sis Trial that was not included in the meta-analysis, a lower target (systolic BP <130 mmHg) was associated with significantly less AF than a target of

<140 mmHg.[90] Taken together, these four trials suggest that lower BP targets would be beneficial for AF prevention.

Individual randomized controlled trials have provided heterogenous data on whether antihypertensive therapy in general reduces AF risk. However, a meta-analysis by Emdin et al. supported that antihypertensive medications, irrespective of whether used for BP lowering, reduced the risk of AF by 10% versus placebo.[91] The proportional effects differed significantly between trials and the benefits appeared larger in patients with heart failure in whom antihypertensive therapy lowered AF risk by 19% versus placebo **(Key Point 6, see Highlight Section)**.[91]

The optimal antihypertensive drug class for AF prevention remains debated, but BP lowering therapy with drugs acting on the renin-angiotensin-aldosterone system may have differential effects on AF prevention (**Figure 3**). In the Valsartan Antihypertensive Long-term Use Evaluation (VALUE) trial, valsartan lowered BP less than amlodipine but produced significantly less AF.[92] In the LIFE trial comparing losartan versus atenolol, there was a 21% reduction in new onset AF with angiotensin-receptor blocker (ARB) use.[93] In the Captopril Prevention Project (CAPPP) and the Second Swedish Trial in Old Patients with Hypertension (STOP-Hypertension-2), there was no significant reduction in AF with angiotensin-converting enzyme (ACE) inhibitors compared with beta-blockers, calcium-channel blockers, and diuretics[94] but results were based on adverse event reports which do not provide robust evidence of AF prevention. In the Antihypertensive and Lipid-Lowering Treatment to Prevent Heart Attack Trial (ALLHAT), lisinopril was not associated with reduced AF compared with a calcium channel blocker or diuretic amongst older patients with a history of hypertension,[95] although this may be due to less BP-lowering with the ACE-inhibitor treated patients. In the meta-analysis by Schneider et al,[96] renin-angiotensin system inhibition with ACE inhibitors or ARB reduced the odds ratio for AF by 33%, with

heterogeneity among trials. In this analysis,[96] renin-angiotensin system inhibition was effective in patients with heart failure and those with hypertension and left ventricular hypertrophy but not post-myocardial infarction.

These mixed findings may reflect the underlying pathophysiology and differential mechanisms of BP-lowering agents, for example, reduction in intracardiac (atrial) pressures and remodelling, seen with ACE/ARB classes of drugs (**Figure 3**).[20] There may also be impact on extracellular matrix turnover and atrial fibrosis, as well as left atrial cardiopathy or left ventricular hypertrophy with ACE/ARB drugs.[97] The discordant results observed in BP-lowering trials suggest that there may be some differential benefit of BP-lowering agents on AF, and that ACE inhibitors and ARBs in particular could be useful for AF prevention **(Key Point 7, see Highlight Section)**.[91]

Conclusions and future directions

AF and hypertension are increasingly prevalent worldwide and both are underdiagnosed and undertreated. Combined screening using increasingly available devices which can detect pulse irregularities or register an ECG inexpensively in parallel with BP measurement may help upscale early detection and treatment, particularly in individuals aged ≥65 years, as recommended by several guidelines for opportunistic AF screening.

The screening activities for hypertension and AF are dependent on the health care system in each country and region but should be closely linked to a pathway for adequate long-term management. Although current data remain mainly observational, the rationale for the combined screening for AF and BP should be considered to reduce costs and overcome logistical challenges.

Major questions remain about the target population for combined screening, the ideal setting ranging from home-based to convenience places, e.g. supermarkets, the frequency, duration and intensity of screening from single timepoint to almost continuous monitoring by wearables or implantable devices and accordingly the exact method of screening. Several important gaps in knowledge have been identified that need to be addressed over the next years (**Table 5**) before combined systematic screening programmes can be recommended and implemented at scale. A trial that could answer the main research question in this domain of whether simultaneous screening for hypertension and AF is beneficial in the general population, is described in **Table 6**. This trial should preferably be conducted using ECG-equipped BP monitors or else separate handheld ECG and BP monitors, which provide a confirmed AF diagnosis at the time of screening. [49,50]

At the present time, expert opinion is to advise the extension and leverage of existing structures for high BP detection and digital technology to provide integrated screening and

healthcare for AF and hypertension worldwide to reduce cardiovascular morbidity and mortality in the population.

Funding

TN has received funding from Finnish Research Council, Sigrid Jusélius Foundation, and the Finnish Foundation for Cardiovascular Research. YG has received funding from the Beijing Natural Science Foundation of China (L232117) and the National Natural Science Foundation of China (82170309). RBS has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme under the grant agreement No 648131, from the European Union's Horizon 2020 research and innovation programme under the grant agreement No 847770 (AFFECT-EU), from the European Union's Horizon Europe research and innovation programme under the grant agreement ID: 101095480 and German Center for Cardiovascular Research (DZHK e.V.) (81Z1710103 and 81Z0710114); German Ministry of Research and Education (BMBF 01ZX1408A) and ERACoSysMed3 (031L0239). Wolfgang Seefried project funding German Heart Foundation. AES is funded by a National Health and Medical Research Council of Australia Investigator Grant (APP2017504). AC is funded by Heart Research UK, Stroke Association, Chief Scientist Office Scotland, Royal College of Physicians and Surgeons of Glasgow, Tenovus Scotland, Mason Medical Research Trust, Pfizer, University of Glasgow, and NHS Greater Glasgow and Clyde. GYHL is a National Institute for Health and Care Research (NIHR) Senior Investigator and co-principal investigator of the AFFIRMO project on multimorbidity in AF, which has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 899871. JHS has received funding from Innovation Fund Denmark and the European Union Horizon 2020 programme: AFFECT-EU. WD has received funding from EU (Horizon 2020), German Ministry of Education and Research, German Center for Cardiovascular Research, Boehringer Ingelheim, and Vifor Pharma. BF Is funded by Australian Government MRFF grants, and a NSW Health Cardiovascular Capacity Building grant.

Disclosures

TN has received speaking honoraria from Servier Finland, Orion Corporation, and AstraZeneca. GN has received advisory board/research support/speaker fees from Abbott, Amgen, Bayer, BMS/Pfizer, Boehringer Ingelheim, Javelin, and Sanofi. RBS has received lecture fees and advisory board fees from BMS/Pfizer and Bayer outside this work. AES has received speaker fees from Omron, Medtronic, Aktiia, Servier, Sanofi, Novartis and is advisory board member for Skylabs and Abbott. AC has received honoraria from BMS, Pfizer, AstraZeneca and Boeheringer Ingelheim. SZD has received consultancy fees from Bristol-Meyers Squibb/Pfizer, Cortrium, and Vital Beats, speaker fees from Bristol-Meyers Squibb/Pfizer and Bayer, travel grants from Abbott and Boston Scientific outside this work. WD has received consulting fees and speaker honoraria from Aimediq, Bayer, Boehringer Ingelheim, Boston Scientific, Cardiomatics, Medtronic, Vifor Pharma, and travel support from Pharmacosmos. BJ has received speaking honoraria from Bayer, BMS/Pfizer, Medtronic, and Daiichi-Sankyo. Research funds from Samjin, Yuhan, Medtronic, Boston Scientific and Abbott Korea. GJH has received honoraria from the American Heart Association (Associate Editor for Circulation), Bristol Myers Squibb (steering committee, AXIOMATIC-SSP trial of milvexian for secondary stroke prevention), and Janssen (Co-chair, Executive Committee Librexia Stroke trial of milvexian for secondary stroke prevention). ML has received lecture fees from Bayer, Sanofi, and BMS/Pfizer. GHM has received lecture fees from Abbott, Biotronik, Microport, BMS/Pfizer and Daiichi Sankyo. SS has received honoraria from Janssen for Executive Committee membership in the Heartline trial; and is a paid scientific advisor for Prolaio and Tempus. GS has received lecture fees from Omron and consulting fees and research grants from Microlife (not related to the present work). RT has received speaking honoraria from Bayer, BMS/Pfizer, and Daiichi-Sankyo. JSH has received research grants and speaking fees from Boston Scientific, Medtronic, Bristol-Meyers Squibb/Pfizer, Servier and Novartis. BF has received honoraria from BMS/Pfizer and Omron.

References

1. NCD Risk Factor Collaboration. Worldwide trends in hypertension prevalence and progress in treatment and control from 1990 to 2019: a pooled analysis of 1201 population-representative studies with 104 million participants. *Lancet*. 2021;398:957-980.
2. Dong XJ, Wang BB, Hou FF, Jiao Y, Li HW, Lv SP, Li FH. Global burden of atrial fibrillation/atrial flutter and its attributable risk factors from 1990 to 2019. *Europace*. 2023;25:793-803.
3. Lippi G, Sanchis-Gomar F, Cervellin G. Global epidemiology of atrial fibrillation: An increasing epidemic and public health challenge. *Int J Stroke*. 2021;16:217-221.
4. Beaney T, Schutte AE, Stergiou GS, Borghi C, Burger D, Charchar F, Cro S, Diaz A, Damasceno A, Espeche W, et al. May Measurement Month 2019: The Global Blood Pressure Screening Campaign of the International Society of Hypertension. *Hypertension*. 2020;76:333-341.
5. Geldsetzer P, Manne-Goehler J, Marcus ME, Ebert C, Zhumadilov Z, Wesseh CS, Tsabedze L, Supiyev A, Sturua L, Bahendeka SK, et al. The state of hypertension care in 44 low-income and middle-income countries: a cross-sectional study of nationally representative individual-level data from 1.1 million adults. *Lancet*. 2019;394:652-662.
6. Mills KT, Stefanescu A, He J. The global epidemiology of hypertension. *Nat Rev Nephrol*. 2020;16:223-237.
7. Yiu KH, Tse HF. Hypertension and cardiac arrhythmias: a review of the epidemiology, pathophysiology and clinical implications. *J Hum Hypertens*. 2008;22:380-388.
8. Chiang CE, Naditch-Brule L, Murin J, Goethals M, Inoue H, O'Neill J, Silva-Cardoso J, Zharinov O, Gamra H, Alam S, et al. Distribution and risk profile of paroxysmal, persistent, and permanent atrial fibrillation in routine clinical practice: insight from the

real-life global survey evaluating patients with atrial fibrillation international registry. *Circ Arrhythm Electrophysiol*. 2012;5:632-639.

9. Ball J, Carrington MJ, McMurray JJ, Stewart S. Atrial fibrillation: profile and burden of an evolving epidemic in the 21st century. *Int J Cardiol*. 2013;167:1807-1824.

10. Schnabel RB, Yin X, Gona P, Larson MG, Beiser AS, McManus DD, Newton-Cheh C, Lubitz SA, Magnani JW, Ellinor PT, et al. 50 year trends in atrial fibrillation prevalence, incidence, risk factors, and mortality in the Framingham Heart Study: a cohort study. *Lancet*. 2015;386:154-162.

11. Garg PK, Wilson N, Yuan Y, Howard VJ, Judd S, Howard G, Soliman EZ. Association of hypertension severity and control with risk of incident atrial fibrillation: The REasons for Geographic And Racial Differences in Stroke (REGARDS) study. *Clin Cardiol*. 2023;46:1418-1425.

12. de Vos CB, Pisters R, Nieuwlaat R, Prins MH, Tieleman RG, Coelen RJ, van den Heijkant AC, Allessie MA, Crijns HJ. Progression from paroxysmal to persistent atrial fibrillation clinical correlates and prognosis. *J Am Coll Cardiol*. 2010;55:725-731.

13. Gage BF, Waterman AD, Shannon W, Boechler M, Rich MW, Radford MJ. Validation of clinical classification schemes for predicting stroke: results from the National Registry of Atrial Fibrillation. *JAMA*. 2001;285:2864-2870.

14. Fang MC, Go AS, Chang Y, Borowsky LH, Pomernacki NK, Udaltsova N, Singer DE. A new risk scheme to predict warfarin-associated hemorrhage: The ATRIA (Anticoagulation and Risk Factors in Atrial Fibrillation) Study. *J Am Coll Cardiol*. 2011;58:395-401.

15. Conen D, Tedrow UB, Koplan BA, Glynn RJ, Buring JE, Albert CM. Influence of systolic and diastolic blood pressure on the risk of incident atrial fibrillation in women. *Circulation*. 2009;119:2146-2152.

16. Grundvold I, Skretteberg PT, Liestøl K, Erikssen G, Kjeldsen SE, Arnesen H, Erikssen J, Bodegard J. Upper normal blood pressures predict incident atrial

fibrillation in healthy middle-aged men: a 35-year follow-up study. *Hypertension*. 2012;59:198-204.

17. Rattani A, Claxton JS, Ali MK, Chen LY, Soliman EZ, Alvaro A. Association and impact of hypertension defined using the 2017 AHA/ACC guidelines on the risk of atrial fibrillation in The Atherosclerosis Risk in Communities study. *BMC Cardiovasc Disord*. 2019;19:262.

18. Kim J, Kim D, Jang E, Kim D, You SC, Yu HT, Lee MY, Lip G, Yang PS, Joung B. Associations of high-normal blood pressure and impaired fasting glucose with atrial fibrillation. *Heart*. 2023;109:929-935.

19. Chen Y, Zhang W, Sheng CS, Huang QF, Cheng YB, Guo QH, Zhang DY, Li Y, Freedman B, Wang JG. A prospective study on the association between atrial fibrillation and blood pressure in an elderly Chinese population. *Int J Cardiol*. 2023;372:113-119.

20. Emdin CA, Anderson SG, Salimi-Khorshidi G, Woodward M, MacMahon S, Dwyer T, Rahimi K. Usual blood pressure, atrial fibrillation and vascular risk: evidence from 4.3 million adults. *Int J Epidemiol*. 2017;46:162-172.

21. Georgiopoulos G, Ntritsos G, Stamatelopoulos K, Tsioufis C, Aimo A, Masi S, Evangelou E. The relationship between blood pressure and risk of atrial fibrillation: a Mendelian randomization study. *Eur J Prev Cardiol*. 2021;29:1494-1500.

22. Rossi GP. Primary Aldosteronism: JACC State-of-the-Art Review. *J Am Coll Cardiol*. 2019;74:2799-2811.

23. Milliez P, Girerd X, Plouin PF, Blacher J, Safar ME, Mourad JJ. Evidence for an increased rate of cardiovascular events in patients with primary aldosteronism. *J Am Coll Cardiol*. 2005;45:1243-1248.

24. Hundemer GL, Curhan GC, Yozamp N, Wang M, Vaidya A. Incidence of Atrial Fibrillation and Mineralocorticoid Receptor Activity in Patients With Medically and Surgically Treated Primary Aldosteronism. *JAMA Cardiol*. 2018;3:768-774.

25. Rossi GP, Maiolino G, Flego A, Belfiore A, Bernini G, Fabris B, Ferri C, Giacchetti G, Letizia C, Maccario M, et al. Adrenalectomy Lowers Incident Atrial Fibrillation in Primary Aldosteronism Patients at Long Term. *Hypertension*. 2018;71:585-591.
26. GBD 2017 Diet Collaborators. Health effects of dietary risks in 195 countries, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017. *Lancet*. 2019;393:1958-1972.
27. Neal B, Wu Y, Feng X, Zhang R, Zhang Y, Shi J, Zhang J, Tian M, Huang L, Li Z, et al. Effect of Salt Substitution on Cardiovascular Events and Death. *N Engl J Med*. 2021;385:1067-1077.
28. Paakko TJW, Perkiomaki JS, Silaste ML, Bloigu R, Huikuri HV, Antero Kesaniemi Y, Ukkola OH. Dietary sodium intake is associated with long-term risk of new-onset atrial fibrillation. *Ann Med*. 2018;50:694-703.
29. Bhagavathula AS, Rahmani J. Salt intake and new-onset of atrial fibrillation: A meta-analysis of over 1.4 million participants. *Clin Nutr*. 2021;40:2600-2601.
30. Ntaios G, Papavasileiou V, Diener HC, Makaritsis K, Michel P. Nonvitamin-K-antagonist oral anticoagulants versus warfarin in patients with atrial fibrillation and previous stroke or transient ischemic attack: An updated systematic review and meta-analysis of randomized controlled trials. *Int J Stroke*. 2017;12:589-596.
31. Paciaroni M, Agnelli G, Falocci N, Tsivgoulis G, Vadikolias K, Liantinioti C, Chondrogianni M, Bovi P, Carletti M, Cappellari M, et al. Early Recurrence and Major Bleeding in Patients With Acute Ischemic Stroke and Atrial Fibrillation Treated With Non-Vitamin-K Oral Anticoagulants (RAF-NOACs) Study. *Journal of the American Heart Association*. 2017;6 e007034.
32. Paciaroni M, Agnelli G, Caso V, Tsivgoulis G, Furie KL, Tadi P, Becattini C, Falocci N, Zedde M, Abdul-Rahim AH, et al. Prediction of Early Recurrent Thromboembolic Event and Major Bleeding in Patients With Acute Stroke and Atrial Fibrillation by a Risk Stratification Schema: The ALESSA Score Study. *Stroke*. 2017;48:726-732.

33. Ntaios G, Vemmou A, Koroboki E, Savvari P, Makaritsis K, Saliaris M, Andrikopoulos G, Vemmos K. The type of atrial fibrillation is associated with long-term outcome in patients with acute ischemic stroke. *Int J Cardiol*. 2013;167:1519-1523.
34. Ntaios G, Hart RG. Embolic Stroke. *Circulation*. 2017;136:2403-2405.
35. Yu JG, Zhou RR, Cai GJ. From hypertension to stroke: mechanisms and potential prevention strategies. *CNS neuroscience & therapeutics*. 2011;17:577-584.
36. Rapsomaniki E, Timmis A, George J, Pujades-Rodriguez M, Shah AD, Denaxas S, White IR, Caulfield MJ, Deanfield JE, Smeeth L, et al. Blood pressure and incidence of twelve cardiovascular diseases: lifetime risks, healthy life-years lost, and age-specific associations in 1.25 million people. *Lancet*. 2014;383:1899-1911.
37. McGrath ER, Beiser AS, DeCarli C, Plourde KL, Vasan RS, Greenberg SM, Seshadri S. Blood pressure from mid- to late life and risk of incident dementia. *Neurology*. 2017;89:2447-2454.
38. Santisteban MM, Iadecola C, Carnevale D. Hypertension, Neurovascular Dysfunction, and Cognitive Impairment. *Hypertension*. 2023;80:22-34.
39. O'Donnell MJ, Xavier D, Liu L, Zhang H, Chin SL, Rao-Melacini P, Rangarajan S, Islam S, Pais P, McQueen MJ, et al. Risk factors for ischaemic and intracerebral haemorrhagic stroke in 22 countries (the INTERSTROKE study): a case-control study. *Lancet*. 2010;376:112-123.
40. Kuzma E, Lourida I, Moore SF, Levine DA, Ukoumunne OC, Llewellyn DJ. Stroke and dementia risk: A systematic review and meta-analysis. *Alzheimers Dement*. 2018;14:1416-1426.
41. Lu Y, Fulop T, Gwee X, Lee TS, Lim WS, Chong MS, Yap PLK, Yap KB, Pan F, Ng TP. Cardiometabolic and Vascular Disease Factors and Mild Cognitive Impairment and Dementia. *Gerontology*. 2022;68:1061-1069.
42. Rivard L, Friberg L, Conen D, Healey JS, Berge T, Boriani G, Brandes A, Calkins H, Camm AJ, Yee Chen L, et al. Atrial Fibrillation and Dementia: A Report From the AF-SCREEN International Collaboration. *Circulation*. 2022;145:392-409.

43. Olesen JB, Lip GY, Hansen ML, Hansen PR, Tolstrup JS, Lindhardsen J, Selmer C, Ahlehoff O, Olsen AM, Gislason GH, et al. Validation of risk stratification schemes for predicting stroke and thromboembolism in patients with atrial fibrillation: nationwide cohort study. *BMJ*. 2011;342:d124.
44. Tanner L, Kenny R, Still M, Ling J, Pearson F, Thompson K, Bhardwaj-Gosling R. NHS Health Check programme: a rapid review update. *BMJ Open*. 2022;12:e052832.
45. Health Service Executive. Chronic Disease Treatment Programme. Available at: https://www.hse.ie/eng/about/who/gmscontracts/2019agreement/chronic-disease-management-programme/. Accessed November 15, 2024.
46. Chinese Society of Cardiology CMA, Heart Rhythm Committee of Chinese Society of Biomedical E. [Chinese guidelines on diagnosis and management of atrial fibrillation]. *Zhonghua Xin Xue Guan Bing Za Zhi*. 2023;51:572-618.
47. Jeemon P, Severin T, Amodeo C, Balabanova D, Campbell NRC, Gaita D, Kario K, Khan T, Melifonwu R, Moran A, et al. World Heart Federation Roadmap for Hypertension - A 2021 Update. *Glob Heart*. 2021;16:63.
48. Freedman B, Hindricks G, Banerjee A, Baranchuk A, Ching CK, Du X, Fitzsimons D, Healey JS, Ikeda T, Lobban TCA, et al. World Heart Federation Roadmap on Atrial Fibrillation - A 2020 Update. *Glob Heart*. 2021;16:41.
49. Hakobyan Z, Zelveian P, Topouchian J, Hazarapetyan L, Asmar R. Validation of the Withings BPM Core Device for Self-Blood Pressure Measurements in General Population According to the Association for the Advancement of Medical Instrumentation/European Society of Hypertension/International Organization for Standardization Universal Standard. *Vasc Health Risk Manag*. 2023;19:391-398.
50. Senoo K, Yukawa A, Ohkura T, Shoji K, Takigami M, Iwakoshi H, Nishimura T, Nakata M, Teramukai S, Matoba S. Screening for untreated atrial fibrillation in the elderly population: A community-based study. *PLoS One*. 2022;17:e0269506.

51. Gawalko M, Linz D. Atrial Fibrillation Detection and Management in Hypertension. *Hypertension*. 2023;80:523-533.
52. Wiesel J, Wiesel D, Suri R, Messineo FC. The use of a modified sphygmomanometer to detect atrial fibrillation in outpatients. *Pacing Clin Electrophysiol*. 2004;27:639-643.
53. Stergiou GS, Kyriakoulis KG, Stambolliu E, Destounis A, Karpettas N, Kalogeropoulos P, Kollias A. Blood pressure measurement in atrial fibrillation: review and meta-analysis of evidence on accuracy and clinical relevance. *J Hypertens*. 2019;37:2430-2441.
54. Hindricks G, Potpara T, Dagres N, Arbelo E, Bax JJ, Blomstrom-Lundqvist C, Boriani G, Castella M, Dan GA, Dilaveris PE, et al. 2020 ESC Guidelines for the diagnosis and management of atrial fibrillation developed in collaboration with the European Association for Cardio-Thoracic Surgery (EACTS): The Task Force for the diagnosis and management of atrial fibrillation of the European Society of Cardiology (ESC) Developed with the special contribution of the European Heart Rhythm Association (EHRA) of the ESC. *Eur Heart J*. 2021;42:373-498.
55. Kollias A, Destounis A, Kalogeropoulos P, Kyriakoulis KG, Ntineri A, Stergiou GS. Atrial Fibrillation Detection During 24-Hour Ambulatory Blood Pressure Monitoring: Comparison With 24-Hour Electrocardiography. *Hypertension*. 2018;72:110-115.
56. Williams GJ, Al-Baraikan A, Rademakers FE, Ciravegna F, van de Vosse FN, Lawrie A, Rothman A, Ashley EA, Wilkins MR, Lawford PV, et al. Wearable technology and the cardiovascular system: the future of patient assessment. *Lancet Digit Health*. 2023;5:e467-e476.
57. Ishizawa M, Noma T, Izumi T, Tani R, Inoue T, Nasu E, Tobiume A, Hasui Y, Yokoyama S, Hamaya H, et al. Development of a Novel Algorithm to Detect Atrial Fibrillation Using an Automated Blood Pressure Monitor With an Irregular Heartbeat Detector. *Circ J*. 2019;83:2428-2433.

58. Watanabe T, Hoshide S, Kario K. New concept of pulse irregularity for the detection of atrial fibrillation during blood pressure measurement. *Hypertens Res*. 2022;45:1520-1522.
59. Suwanwela NC, Chutinet A, Autjimanon H, Ounahachok T, Decha-Umphai C, Chockchai S, Indrabhakti S, Kijpaisalratana N, Akarathanawat W, Travanichakul S, et al. Atrial fibrillation prevalence and risk profile from novel community-based screening in Thailand: A prospective multi-centre study. *Int J Cardiol Heart Vasc*. 2021;32:100709.
60. Denas G, Battaggia A, Fusello M, Franco-Novelletto B, Cancian M, Scalisi A, Pengo V. General population screening for atrial fibrillation with an automated rhythm-detection blood pressure device. *Int J Cardiol*. 2021;322:265-270.
61. Bacchini M, Bonometti S, Del Zotti F, Lechi A, Realdon F, Fava C, Minuz P. Opportunistic Screening for Atrial Fibrillation in the Pharmacies: A Population-Based Cross-Sectional Study. *High Blood Press Cardiovasc Prev*. 2019;26:339-344.
62. Lindholt JS, Sogaard R, Rasmussen LM, Mejldal A, Lambrechtsen J, Steffensen FH, Frost L, Egstrup K, Urbonaviciene G, Busk M, et al. Five-Year Outcomes of the Danish Cardiovascular Screening (DANCAVAS) Trial. *N Engl J Med*. 2022;387:1385-1394.
63. Healey JS, Connolly SJ, Gold MR, Israel CW, Van Gelder IC, Capucci A, Lau CP, Fain E, Yang S, Bailleul C, et al. Subclinical atrial fibrillation and the risk of stroke. *N Engl J Med*. 2012;366:120-129.
64. Svennberg E, Friberg L, Frykman V, Al-Khalili F, Engdahl J, Rosenqvist M. Clinical outcomes in systematic screening for atrial fibrillation (STROKESTOP): a multicentre, parallel group, unmasked, randomised controlled trial. *Lancet*. 2021;398:1498-1506.
65. Svendsen JH, Diederichsen SZ, Hojberg S, Krieger DW, Graff C, Kronborg C, Olesen MS, Nielsen JB, Holst AG, Brandes A, et al. Implantable loop recorder detection of atrial fibrillation to prevent stroke (The LOOP Study): a randomised controlled trial. *Lancet*. 2021;398:1507-1516.

66. Steinhubl SR, Waalen J, Edwards AM, Ariniello LM, Mehta RR, Ebner GS, Carter C, Baca-Motes K, Felicione E, Sarich T, et al. Effect of a Home-Based Wearable Continuous ECG Monitoring Patch on Detection of Undiagnosed Atrial Fibrillation: The mSToPS Randomized Clinical Trial. *JAMA*. 2018;320:146-155.

67. Gladstone DJ, Wachter R, Schmalstieg-Bahr K, Quinn FR, Hummers E, Ivers N, Marsden T, Thornton A, Djuric A, Suerbaum J, et al. Screening for Atrial Fibrillation in the Older Population: A Randomized Clinical Trial. *JAMA Cardiol*. 2021;6:558-567.

68. Meschia JF, Bushnell C, Boden-Albala B, Braun LT, Bravata DM, Chaturvedi S, Creager MA, Eckel RH, Elkind MS, Fornage M, et al. Guidelines for the primary prevention of stroke: a statement for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke*. 2014;45:3754-3832.

69. Force USPST, Davidson KW, Barry MJ, Mangione CM, Cabana M, Caughey AB, Davis EM, Donahue KE, Doubeni CA, Epling JW, Jr., et al. Screening for Atrial Fibrillation: US Preventive Services Task Force Recommendation Statement. *JAMA*. 2022;327:360-367.

70. Joglar JA, Chung MK, Armbruster AL, Benjamin EJ, Chyou JY, Cronin EM, Deswal A, Eckhardt LL, Goldberger ZD, Gopinathannair R, et al. 2023 ACC/AHA/ACCP/HRS Guideline for the Diagnosis and Management of Atrial Fibrillation: A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. *Circulation*. 2024;149:e1-e156.

71. Lubitz SA, Faranesh AZ, Selvaggi C, Atlas SJ, McManus DD, Singer DE, Pagoto S, McConnell MV, Pantelopoulos A, Foulkes AS. Detection of Atrial Fibrillation in a Large Population Using Wearable Devices: The Fitbit Heart Study. *Circulation*. 2022;146:1415-1424.

72. Xing LY, Diederichsen SZ, Hojberg S, Krieger DW, Graff C, Olesen MS, Brandes A, Kober L, Haugan KJ, Svendsen JH. Systolic Blood Pressure and Effects of Screening for Atrial Fibrillation With Long-Term Continuous Monitoring (a LOOP Substudy). *Hypertension*. 2022;79:2081-2090.

73. Diederichsen SZ, Haugan KJ, Brandes A, Lanng MB, Graff C, Krieger D, Kronborg C, Holst AG, Kober L, Hojberg S, et al. Natural History of Subclinical Atrial Fibrillation Detected by Implanted Loop Recorders. *Journal of the American College of Cardiology*. 2019;74:2771-2781.

74. Diederichsen SZ, Haugan KJ, Brandes A, Graff C, Krieger D, Kronborg C, Holst AG, Nielsen JB, Kober L, Hojberg S, et al. Incidence and predictors of atrial fibrillation episodes as detected by implantable loop recorder in patients at risk: From the LOOP study. *Am Heart J*. 2020;219:117-127.

75. Uittenbogaart SB, Verbiest-van Gurp N, Lucassen WAM, Winkens B, Nielen M, Erkens PMG, Knottnerus JA, van Weert H, Stoffers H. Opportunistic screening versus usual care for detection of atrial fibrillation in primary care: cluster randomised controlled trial. *BMJ*. 2020;370:m3208.

76. Gudmundsdottir KK, Fredriksson T, Svennberg E, Al-Khalili F, Friberg L, Frykman V, Hijazi Z, Rosenqvist M, Engdahl J. Stepwise mass screening for atrial fibrillation using N-terminal B-type natriuretic peptide: the STROKESTOP II study. *Europace*. 2020;22:24-32.

77. Schnabel RB, Wild PS, Wilde S, Ojeda FM, Schulz A, Zeller T, Sinning CR, Kunde J, Lackner KJ, Munzel T, et al. Multiple biomarkers and atrial fibrillation in the general population. *PLoS One*. 2014;9:e112486.

78. Xing LY, Diederichsen SZ, Hojberg S, Krieger DW, Graff C, Frikke-Schmidt R, Olesen MS, Brandes A, Kober L, Haugan KJ, et al. Effects of Atrial Fibrillation Screening According to N-Terminal Pro-B-Type Natriuretic Peptide: A Secondary Analysis of the Randomized LOOP Study. *Circulation*. 2023;147:1788-1797.

79. Freedman B, Camm J, Calkins H, Healey JS, Rosenqvist M, Wang J, Albert CM, Anderson CS, Antoniou S, Benjamin EJ, et al. Screening for Atrial Fibrillation: A Report of the AF-SCREEN International Collaboration. *Circulation*. 2017;135:1851-1867.

80. Williams K, Modi RN, Dymond A, Hoare S, Powell A, Burt J, Edwards D, Lund J, Johnson R, Lobban T, et al. Cluster randomised controlled trial of screening for atrial fibrillation in people aged 70 years and over to reduce stroke: protocol for the pilot study for the SAFER trial. *BMJ Open*. 2022;12:e065066.
81. Brandes A, Stavrakis S, Freedman B, Antoniou S, Boriani G, Camm AJ, Chow CK, Ding E, Engdahl J, Gibson MM, et al. Consumer-Led Screening for Atrial Fibrillation: Frontier Review of the AF-SCREEN International Collaboration. *Circulation*. 2022;146:1461-1474.
82. Springer MV, Malani P, Solway E, Kirch M, Singer DC, Kullgren JT, Levine DA. Prevalence and Frequency of Self-measured Blood Pressure Monitoring in US Adults Aged 50-80 Years. *JAMA Netw Open*. 2022;5:e2231772.
83. Ancker JS, Witteman HO, Hafeez B, Provencher T, Van de Graaf M, Wei E. "You Get Reminded You're a Sick Person": Personal Data Tracking and Patients With Multiple Chronic Conditions. *J Med Internet Res*. 2015;17:e202.
84. Logan AG, Irvine MJ, McIsaac WJ, Tisler A, Rossos PG, Easty A, Feig DS, Cafazzo JA. Effect of home blood pressure telemonitoring with self-care support on uncontrolled systolic hypertension in diabetics. *Hypertension*. 2012;60:51-57.
85. Okin PM, Hille DA, Larstorp AC, Wachtell K, Kjeldsen SE, Dahlöf B, Devereux RB. Effect of lower on-treatment systolic blood pressure on the risk of atrial fibrillation in hypertensive patients. *Hypertension*. 2015;66:368-373.
86. Thomas MC, Dublin S, Kaplan RC, Glazer NL, Lumley T, Longstreth WT, Jr., Smith NL, Psaty BM, Siscovick DS, Heckbert SR. Blood pressure control and risk of incident atrial fibrillation. *Am J Hypertens*. 2008;21:1111-1116.
87. Chen LY, Bigger JT, Hickey KT, Chen H, Lopez-Jimenez C, Banerji MA, Evans G, Fleg JL, Papademetriou V, Thomas A, et al. Effect of Intensive Blood Pressure Lowering on Incident Atrial Fibrillation and P-Wave Indices in the ACCORD Blood Pressure Trial. *Am J Hypertens*. 2016;29:1276-1282.

88. Vagaonescu TD, Wilson AC, Kostis JB. Atrial fibrillation and isolated systolic hypertension: the systolic hypertension in the elderly program and systolic hypertension in the elderly program-extension study. *Hypertension*. 2008;51:1552-1556.

89. Zhang W, Wang JG. Prevention of Atrial Fibrillation by Intensive Antihypertensive Treatment. *Hypertension*. 2020;75:1414-1416.

90. Verdecchia P, Staessen JA, Angeli F, de Simone G, Achilli A, Ganau A, Mureddu G, Pede S, Maggioni AP, Lucci D, et al. Usual versus tight control of systolic blood pressure in non-diabetic patients with hypertension (Cardio-Sis): an open-label randomised trial. *Lancet*. 2009;374:525-533.

91. Emdin CA, Callender T, Cao J, Rahimi K. Effect of antihypertensive agents on risk of atrial fibrillation: a meta-analysis of large-scale randomized trials. *Europace*. 2015;17:701-710.

92. Schmieder RE, Kjeldsen SE, Julius S, McInnes GT, Zanchetti A, Hua TA. Reduced incidence of new-onset atrial fibrillation with angiotensin II receptor blockade: the VALUE trial. *J Hypertens*. 2008;26:403-411.

93. Wachtell K, Lehto M, Gerdts E, Olsen MH, Hornestam B, Dahlöf B, Ibsen H, Julius S, Kjeldsen SE, Lindholm LH, et al. Angiotensin II receptor blockade reduces new-onset atrial fibrillation and subsequent stroke compared to atenolol: the Losartan Intervention For End Point Reduction in Hypertension (LIFE) study. *J Am Coll Cardiol*. 2005;45:712-719.

94. Healey JS, Baranchuk A, Crystal E, Morillo CA, Garfinkle M, Yusuf S, Connolly SJ. Prevention of atrial fibrillation with angiotensin-converting enzyme inhibitors and angiotensin receptor blockers: a meta-analysis. *J Am Coll Cardiol*. 2005;45:1832-1839.

95. Dewland TA, Soliman EZ, Yamal JM, Davis BR, Alonso A, Albert CM, Simpson LM, Haywood LJ, Marcus GM. Pharmacologic Prevention of Incident Atrial Fibrillation: Long-Term Results From the ALLHAT (Antihypertensive and Lipid-Lowering

Treatment to Prevent Heart Attack Trial). *Circ Arrhythm Electrophysiol*. 2017;10:e005463.

96. Schneider MP, Hua TA, Böhm M, Wachtell K, Kjeldsen SE, Schmieder RE. Prevention of atrial fibrillation by Renin-Angiotensin system inhibition a meta-analysis. *J Am Coll Cardiol*. 2010;55:2299-2307.

97. Wachtell K, Devereux RB, Lyle PA, Okin PM, Gerdts E. The left atrium, atrial fibrillation, and the risk of stroke in hypertensive patients with left ventricular hypertrophy. *Ther Adv Cardiovasc Dis*. 2008;2:507-513.

Tables

Table 1. Selected results from observational studies on the association between hypertension and AF

Author, Year	Country or a meta-analysis	Cohort	Incidence (Per 1000 Person Years, or %)	Risk of Atrial Fibrillation, Hazard Ratio (95% CI)
Conen, 2009[15]	Women's Health Study	N=34,221; 55 ± 7 y; 100% women		Systolic BP<120; reference 120-129; 1.00 (0.78-1.28) 130-139; 1.28 (1.00-1.63) 140-159; 1.56 (1.22-2.01) ≥160; 2.74 (1.77-4.22)
Grundvold, 2012[16]	Five governmental institutions in Oslo, Norway	N=2014; 50 y; healthy men; 100% men		Systolic BP<128 mmHg; reference 128-138; 1.50 (1.10-2.03) ≥140; 1.60 (1.15-2.21)
Rattani, 2019[17]	Atherosclerosis Risk in Communities (ARIC)	N=14,915; 54.1 ± 5.7 y; 55.3% women	No hypertension; 6.5 Prehypertension; 9.3 Hypertension; 12.5	No hypertension; reference Prehypertension; 1.24 (1.12-1.36) Hypertension; 1.58 (1.44-1.74)
Kim et al, 2023[18]	Korean National Sample Cohort, Republic of Korea	N=176,937; 47% women	No hypertension; 1.68 High-normal BP; 2.21	No hypertension; reference High-normal BP; 1.11 (1.02-1.21)
Kim et al, 2023[18]	UK Biobank	N=167,946; 63% women	No hypertension; 2.31 High-normal BP; 3.29	No hypertension; reference High-normal BP; 1.07 (1.01-1.13)

Prehypretension: between 120/80 and 139/89; High-normal BP: between 130/85 and 139/89; SBP, systolic BP; AF, atrial fibrillation; BP, blood pressure, CI; confidence interval; med, medication; w, with; w/o; without

Table 2. Recent observational studies regarding AF detection during automated blood pressure measurement.

Study	Method	Year	Country	N	Age	Device	Sensitivity / Specificity
Validation studies							
Ishizawa et al. [57]	Office device	2019	Japan	303	72±14	Omron HEM-907	95/97
Watanabe et al. [58]	Home device	2021	Japan	280	57±12	A&D UA-1020	100/97
Kollias et al. [55]	Ambulatory device	2018	Greece	100	71±8	Microlife WatchBP O3 Afib	93/87
Population studies							**AF Prevalence (%)**
Suwanwela et al. [59]	Home visits	2021	Thailand	13,864	73±6	Microlife A200 AFib	2.8
Denas et al. [60]	Doctors' office	2021	Italy	14,987	76±7	Microlife WatchBP Office Afib	3.2
Bacchini et al. [61]	Pharmacies	2019	Italy	3,071	67±10	Microlife AFib	3.2

Table 3. Detection of hypertension and atrial fibrillation in randomized clinical trials

Study name	N	Screening method and design	Inclusion criteria	Duration of Follow-up	Main results
Detection of AF and hypertension from randomized trials					
DANCAVAS[62]	46,611	AF: ECG monitoring during computed tomography scan; BP: routine measurements	Men aged 65-74 years	5.6 years	9% of all had "potential hypertension" defined as ≥ 160/100; 0.5% of all were diagnosed with AF. However, the study was not designed to study AF and HTN detection as main outcomes.
Detection of AF from randomized trials					
ASSERT[63]	2,580	Episode recordings from pacemaker/ICD	>65 years, HTN and with DDD pacemaker or ICD within 8 wks	2.5 years	By 3 months, subclinical atrial tachyarrhythmias detected by implanted devices was seen in 10.1%.
STROKESTOP[64]	27,768	Hand-held single-lead ECG recordings twice daily for 2 weeks vs. standard care	75 or 76 years old	6.9 years	During FU detection of AF increased from around 12% in both groups to around 20% in both groups.
LOOP[65]	6,004	Implantable loop recorder vs. standard care	>70 years of age and at least 1 comorbidity (HTN, DM, previous stroke, or HF)	5.4 years	AF was diagnosed in 32% in the implantable loop recorder group versus 12.2% in the control group (hazard ratio 3.17 [95% CI 2.81–3.59]; p<0.0001).
m-STOPS[66]	2,659	Self-applied ECG patch for 2 weeks vs. standard care.	Age >75 years, male >55 years or female >65 years with >1 comorbidities	4 months to 1 year	Immediate monitoring using a self-applied ECG patch, compared with delaying ECG monitoring for 4 months, led to a significantly higher rate of AF diagnosis at 4 months (3.9% vs 0.9%).
SCREEN-AF[67]	856	ECG patch for 2 weeks at baseline and at 3 months vs. standard care. The screening group also received automated home BP monitors with oscillometric AF screening capability.	Age of 75 or more and known HTN	6 months	AF was detected in 5.3% in the screening group vs 0.5% in the control group (relative risk, 11.2; 95% CI, 2.7-47.1; *P*=0.001; absolute difference, 4.8%; 95% CI, 2.6%-7.0%; *P*<0.001). Compared with continuous ECG, intermittent oscillometric screening with a BP monitor was inferior for detecting paroxysmal AF.

AF, atrial fibrillation; CI, confidence interval; DDD, dual chamber; DM, diabetes mellitus; HTN, hypertension; ICD, implantable cardioverter-defibrillator; HF, heart failure.

Table 4. Results of an online, voluntary survey of 884 members of the AF Association

Question	Response			
Currently have a device to measure blood pressure at home?	Yes – 768 (87%)			No – 116 (13%)
Currently have a device to measure heart rate or rhythm at home?	Yes – 679 (77%)			No – 201 (23%)
How frequently do you use it?	Daily – 232 (35%)	Weekly – 82 (12%)	Monthly – 41 (6%)	With symptoms or other – 319 (47%)
For those who answered yes, does it provide an ECG?	Yes – 331 (49%)			No – 345 (51%)
Does whichever home device you use automatically alert you for atrial fibrillation or other irregular rhythm?	Yes- 399 (54%)			No – 344 (46%)
If you were to measure your blood pressure and heart rhythm at home, would you share the findings with your health provider?	Yes- 664 (82%)			No – 144 (18%)
How frequently would you share the findings?	All results at time of routine appointment – 104 (14%)	Only at the time of an abnormal finding – 323 (45%)	Every time I used it – 27 (4%)	Never – they wouldn't be interested – 104 (14%)
If you currently don't have a home device that can measure your blood pressure, and your heart rate/rhythm, and can alert you that you may have atrial fibrillation or an irregular heart rhythm, would you see such a device being of value to you?	Yes – 407 (76%)			No – 131 (24%)
Assuming it would require 3-5 minutes of your time, how frequently would you imagine using a technology that does all of the above?	Daily – 120 (26%)	Weekly – 145 (31%)	Monthly – 51 (11%)	With symptoms only – 150 (32%)

Table 5. Key knowledge gaps and questions to address on the links between hypertension and atrial fibrillation.

Knowledge gap	Questions to address	Importance
Pathophysiology		
Mechanisms	Why is primary hyperaldosteronism strongly linked with AF?	+
Association of hypertension and AF with outcomes	Is hypertension more strongly related than AF to future risk of heart failure and dementia?	+
Screening		
Selection for screening	Should simultaneous screening for hypertension and AF be recommended in previously healthy individuals?	++
	Should screening for AF be recommended in all hypertensive individuals?	++
	Which patient subgroups benefit the most from simultaneous screening for hypertension and AF?	+++
	Are biomarkers, ECG measurements, and genetics relevant for patient selection?	+
	Should all patients with primary hyperaldosteronism undergo AF screening?	+
Screening method		
	What is the optimal method for simultaneous screening for hypertension and AF in patient-initiated screening?	+++
	What is the optimal method for simultaneous screening for hypertension and AF in the outpatient setting?	+++
	What is the optimal method for simultaneous screening for hypertension and AF in the inpatient setting?	+
	What is the patient experience in simultaneous screening for hypertension and AF?	++
	Can wearable devices be used for reliable simultaneous screening for hypertension and AF?	++
Prevention		
Blood pressure targets	What is the optimal BP target for primary prevention of AF?	++
	What is the optimal BP target for prevention of AF progression in patients with paroxysmal AF?	++
	What is the optimal BP target for prevention of stroke and dementia in patients with AF?	++
Antihypertensive therapy	What is the optimal antihypertensive therapy for AF prevention?	+++

BP, blood pressure; AF, atrial fibrillation.

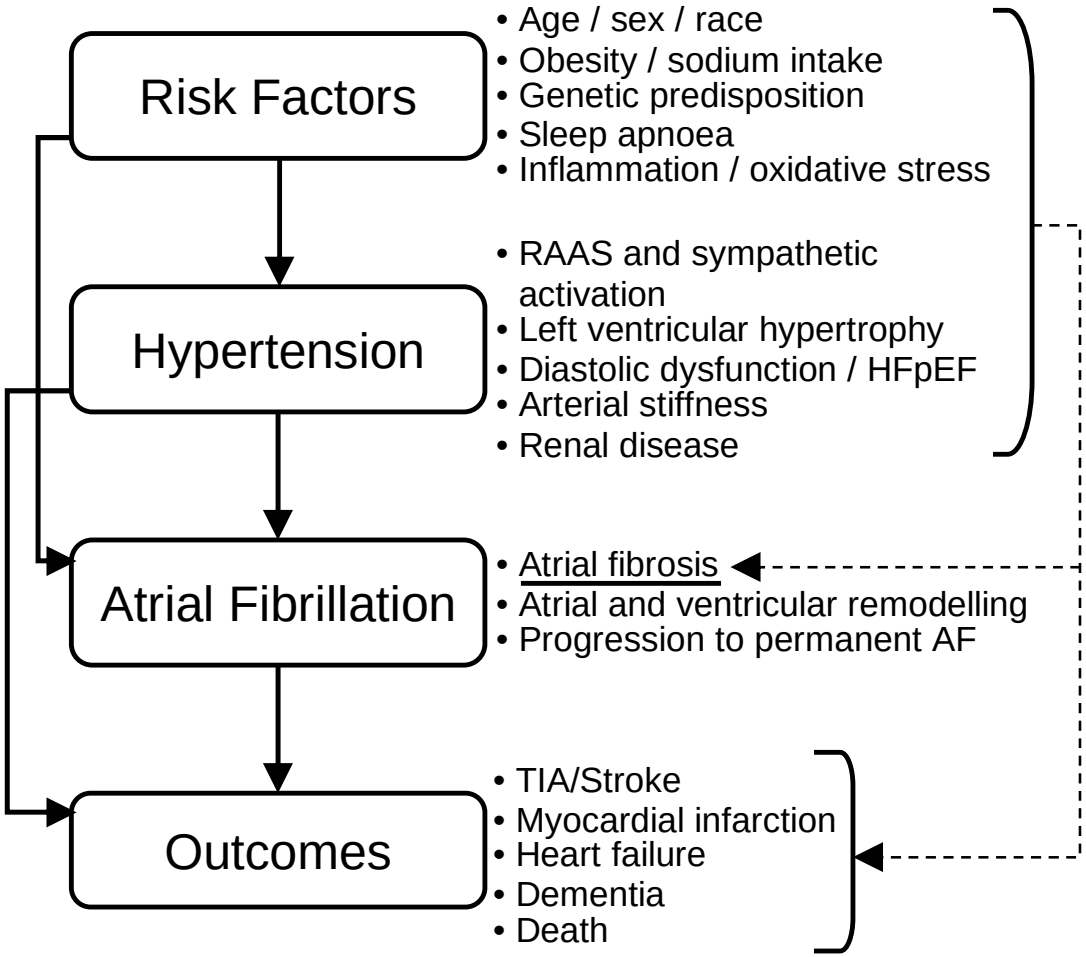
Table 6. Suggestion for potential future trial on simultaneous screening of hypertension and AF.

Main research question	Study sample	Study arms	Screening method	Main outcome	Secondary outcomes	Predefined subgroups
Is simultaneous screening for hypertension and AF beneficial in the general population?	Population sample aged ≥70 years not taking OAC and not in a nursing home or serious illness (same entry criteria as SAFER) [80]	1. Control (no screening) 2. Intervention arms 2A. BP screening only 2B. AF+BP screening	Three weeks screening, four measurements per day with 84 total measurements using a conventional oscillometric upper arm BP monitor (2A) or BP monitor equipped with an ECG recorder (2B) or with separate BP monitor and handheld ECG recorder (2B)	Incident CVD, including MI, stroke, and heart failure	1. Individual CVD components of primary endpoint 2. Incident AF 3. Uncontrolled Hypertension (BP≥130/80 mmHg) 3. Incident dementia 4. Use of antithrombotic medication 5. Bleeding complications	1. Two age strata (70-79, ≥80) 2. Sex 3. Systolic BP level

AF, atrial fibrillation; OAC, oral anticoagulants; SAFER, Screening for Atrial Fibrillation with ECG to Reduce stroke; BP, blood pressure; AF, atrial fibrillation; CVD, cardiovascular disease.

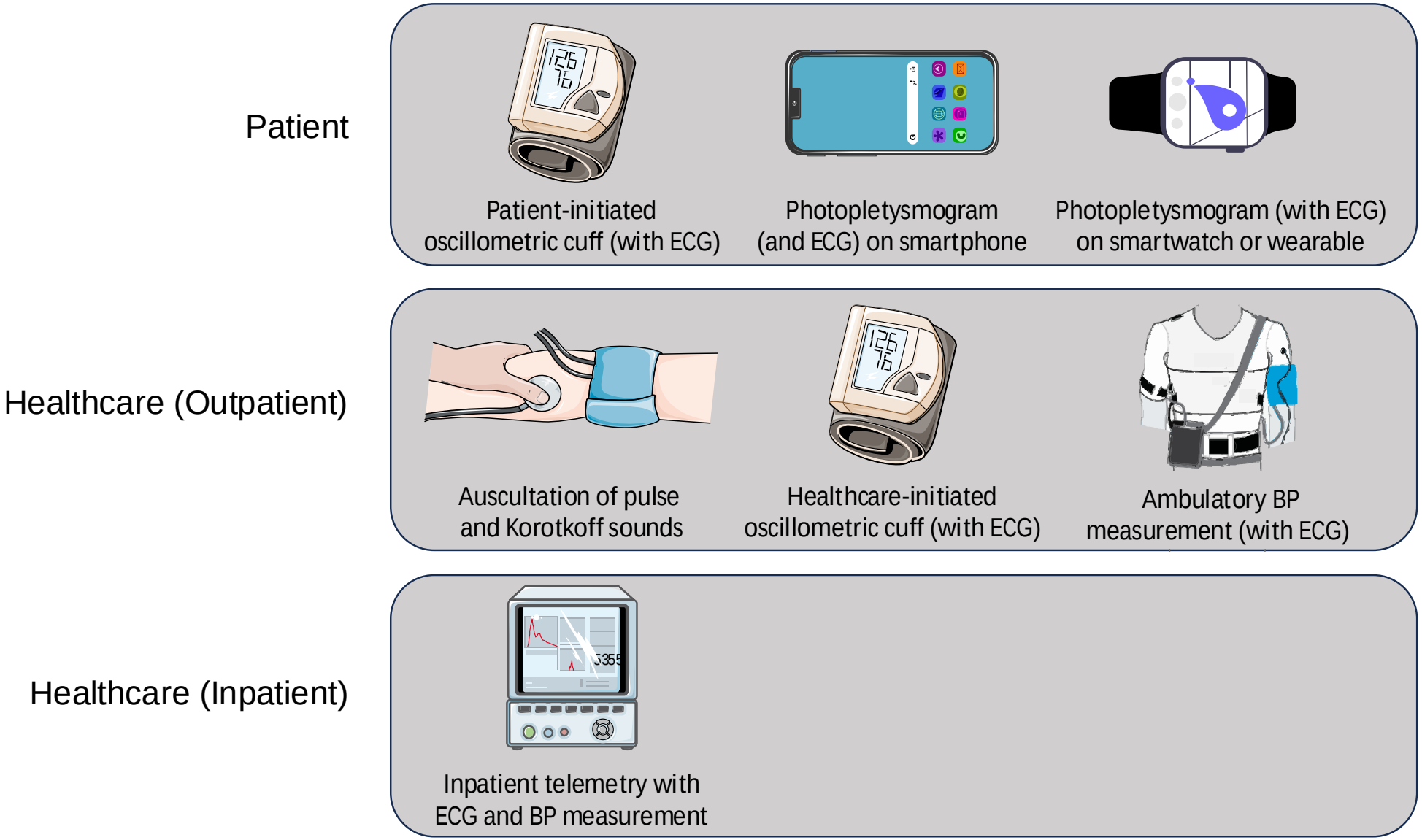
Figures

Figure 1. Progression from risk factors to overt outcomes in hypertension and atrial fibrillation.



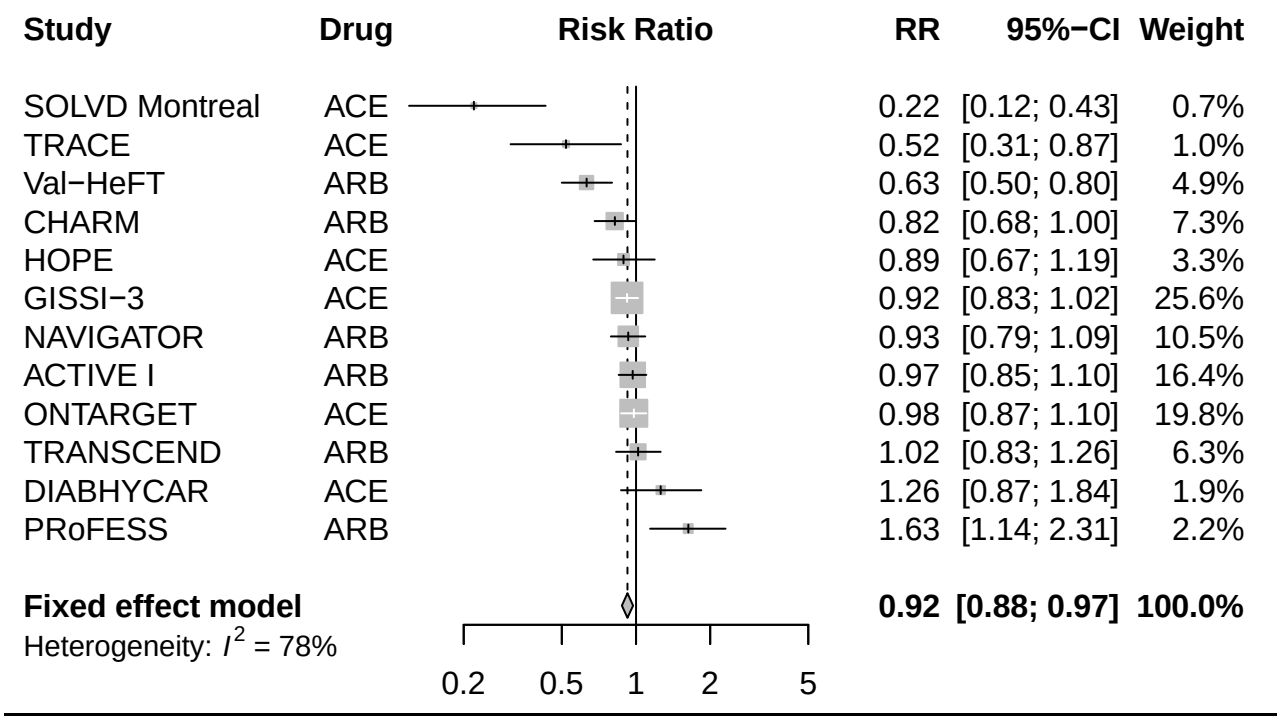
HfpEF, heart failure with preserved ejection fraction; RAAS, renin–angiotensin–aldosterone system; SE, systemic embolism; TIA, transient ischemic attack.

Figure 2. Methods for simultaneous screening for atrial fibrillation and hypertension.



BP, blood pressure. The Figure was partly generated using Servier Medical Art, provided by Servier, licensed under a Creative Commons Attribution 3.0 unported license.

Figure 3. Effect of ACE-inhibitors and ARBs against placebo for prevention of atrial fibrillation.



Effect sizes derived from Emdin et al. [91]

SUPPLEMENTAL MATERIAL

Supplemental results. Key point survey responses of 77 participating members of the AF-SCREEN international collaboration performed between May 30 and June 17 2024. Key points were elaborated by primary and secondary panels of co-authors and the AF-Screen Steering Committee members. Agreement by ≥85% of members who responded was pre-specified for acceptance as a Key Point.

Key point 1: Hypertension is the leading modifiable risk factor for both AF and stroke.

	N= 77	%
Agree	73	94.8
Disagree	4	5.2

Key point 2: More focus should be placed on hypertension for prediction and prevention of AF, rather than merely as a co-morbidity of AF.

	N= 77	%
Agree	73	94.8
Disagree	4	5.2

Key point 3: Hypertension, AF, heart failure, stroke, and many types of dementia are part of a CVD continuum.

	N= 77	%
Agree	74	96.1
Disagree	3	3.9

Key point 4: Positive screening for AF with an oscillometric BP monitor requires ECG confirmation.

	N= 77	%
Agree	75	97.4
Disagree	2	2.6

Key point 5: High-risk individuals aged ≥65 years or with treatment-resistant hypertension could benefit from AF screening.

	N= 77	%
Agree	74	96.1
Disagree	3	3.9

Key point 6: Antihypertensive therapy can effectively lower the risk of developing AF, particularly in patients with left ventricular dysfunction.

	N= 77	%
Agree	69	89.6
Disagree	8	10.4

Key point 7: Inconsistency in the randomized controlled trial data linking BP-lowering with reduced AF risk likely results from differential effects of BP-lowering agents on AF risk.

	N= 77	%
Agree	67	87.0
Disagree	10	13.0

Other Point: Automated upper arm cuff BP devices with implemented technology can be used to simultaneously detect both hypertension and AF with high sensitivity and specificity.

	N= 77	%
Agree	65	84.4
Disagree	12	15.6