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REVIEW

Screening strategies for atrial fibrillation in the elderly population: a systematic review and network meta-analysis

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Abstract

Opportunistic screening for atrial fibrillation (AF) is currently recommended for patients aged 65 years and older. However, this has recently been called into question by two studies that report that opportunistic screening is no more effective than usual care. Furthermore, there seems to be no consensus on which is the most effective screening strategy (opportunistic or systematic). Thus, we aimed to compare the different AF detection strategies with each other using the methodology of systematic review with network meta-analysis. An electronic database search of MEDLINE, CENTRAL, and EMBASE was performed. In addition, we also searched OpenGrey, experts' knowledge and screened the reference list of included studies or other relevant publications. The search was performed on the 2nd of November of 2020 and updated on the 20th of September of 2021. We performed a random-effects pairwise meta-analysis and a random-effects network meta-analysis within a frequentist framework in an intention to screen analysis. We reported the results as relative risk (RR) with 95% confidence intervals (CI). We assessed the confidence in the evidence using the GRADE framework. Nine studies were included, enrolling 80,665 participants. Pooled effect sizes suggested that systematic screening was effective when compared with usual care (RR 2.11; 95% CI 1.48–3.02; high GRADE confidence) and when compared with opportunistic screening (RR 1.86; CI 1.23–2.82; high GRADE confidence) but no significant difference was found between opportunistic screening and usual care (RR 1.13; 95% CI 0.79–1.63; low GRADE confidence). Systematic screening was the most effective strategy for detecting atrial fibrillation in individuals aged 65 years or older. Opportunistic screening was no more effective than usual care, but the results were weakened by a low quality of evidence due to risk of bias of the included studies and imprecision in the results. PROSPERO registration number: CRD42020218672.

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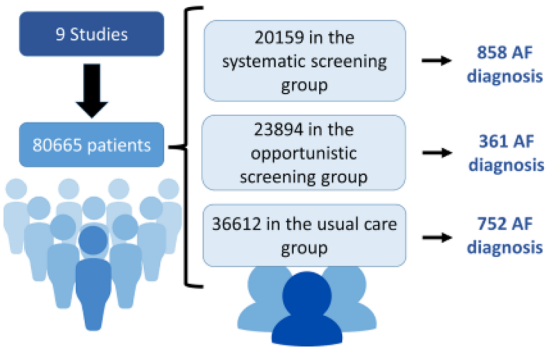
Graphical abstract

SCREENING STRATEGIES FOR ATRIAL FIBRILLATION IN THE ELDERLY POPULATION: A SYSTEMATIC REVIEW AND NETWORK META-ANALYSIS



Comparison	Systematic screening: opportunistic screening	Systematic screening: usual care	Opportunistic screening: usual care
Number of participants (studies)	2	6	3
NMA Relative Effect (95% CI)	**1.86** [1.23; 2.82]	**2.11** [1.48; 3.02]	**1.13** [0.79; 1.63]
Pair-wise Relative Effect (95% CI)	**1.72** [1.01; 2.92]	**2.02** [1.37; 2.98]	**1.19** [0.80; 1.78]
Quality of the evidence (GRADE)	HIGH	HIGH	LOW
Comments			Due to **risk of bias** of the included studies and **imprecision** in the results

Systematic screening was the most effective strategy for detecting atrial fibrillation in individuals aged 65 years or older without a known previous diagnosis. Opportunistic screening was no more effective than usual care, but the results were weakened by a low quality of evidence due to risk of bias of the included studies and imprecision in the results.

Keywords Atrial fibrillation · Screening · Network meta-analysis · Systematic review

Introduction

Rationale

Atrial fibrillation (AF) is the most common sustained supraventricular arrythmia and it is estimated that the prevalence of atrial fibrillation in adults is between 2 and 4% [1] and that the lifetime risk of atrial fibrillation in people of European ancestry is one in three individuals. However, it is expected that the prevalence of atrial fibrillation will increase in the next decades due to the increasing age of the general population [2].

Atrial fibrillation is associated with different outcomes, among which are a fivefold increase of incidence of stroke [3, 4], left ventricle dysfunction [5] and heart failure [6], cognitive decline and vascular dementia [7], depression, impaired quality of life, 10–40% annual hospitalization rate [8], and a 1.5–3.5 fold increase in overall death [9]. These outcomes are not limited to patients with symptomatic atrial fibrillation as patients with asymptomatic atrial fibrillation also have an increased risk of ischaemic stroke [4, 10–13]. This is important to bear in mind because asymptomatic atrial fibrillation is often not diagnosed until an ischaemic stroke has occurred, therefore, it is important to identify patients with undiagnosed atrial fibrillation at risk for stroke to try to prevent this outcome [4, 14, 15].

With this in mind, screening for atrial fibrillation could prove to be a beneficial measure, especially in the elderly population (age ≥ 65 years), considering that the incidence of atrial fibrillation increases with advancing age [16–19].

There are several screening strategies, including opportunistic screening and systematic screening. Opportunistic atrial fibrillation screening, i.e. screening only patients who use health services for an unrelated reason, can be an effective measure to identify individuals with asymptomatic atrial fibrillation [20]. This screening can be done using manual pulse measurement (allowing the detection of an irregular pulse which may indicate the presence of atrial fibrillation) or single lead ECG (which can be automatic using an algorithm, thus reducing the number of ECGs that have to be analysed manually) [21, 22]. However, one study has determined that opportunistic screening in patients aged 65 and over did not increase the detection rate of atrial fibrillation and therefore was not useful in this context [23]. There is, therefore, some controversy regarding the pertinence of opportunistic screening for atrial fibrillation in the population aged 65 or more. Another screening strategy to consider is systematic screening, which consists of inviting all patients aged 65 years or older to be screened in a clinic, outpatient or inpatient setting. This screening can be done at a single time, various times intermittently or continuously, by measuring the pulse, using a single lead ECG, twelve

lead ECG or a patch. A previous meta-analysis showed that there were no significant differences between the different types of screening [24], however, another study reports that opportunistic screening is more cost effective [25]. Thus, with new data but without robust conclusions, we decided to compare the different atrial fibrillation detection strategies with each other using the methodology of systematic review with network meta-analysis (NMA).

The importance of this review is to determine whether different screening strategies lead to a higher number of atrial fibrillation diagnoses in individuals aged 65 years and older and whether this number is statistically and clinically relevant.

Considering the need to compare three different strategies (usual care, opportunistic screening, and systematic screening) a network meta-analysis was performed.

Objective

To determine the efficacy of opportunistic and systematic atrial fibrillation screening strategies in patients aged 65 and older using a network systematic review of the available literature.

Methods

The review protocol was registered in PROSPERO—PROSPERO 2020 CRD42020218672 Available from: https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42020218672. The review protocol was not published in any peer-reviewed journal. Conduct and reporting followed the PRISMA NMA statement [26].

Eligibility criteria and outcomes

We considered randomized controlled trials and cluster randomized controlled trials that addressed different atrial fibrillation detection strategies in individuals aged 65 years or older.

The interventions that were studied were opportunistic and systematic atrial fibrillation screening. Opportunistic screening consisted in screening patients 65 years of age or older who resorted to health services for some reason, by measuring the pulse or using a single lead ECG to detect individuals with atrial fibrillation. Systematic screening consisted in inviting all patients aged 65 years or older to be screened in a clinic, outpatient or inpatient setting and was implemented either at a single time, various times intermittently or continuously, by measuring the pulse, using a single lead ECG, twelve lead ECG or a patch in order to detect individuals with atrial fibrillation. The control consisted in usual clinical practice without atrial fibrillation screening.

Our outcome measure was atrial fibrillation diagnosis.

Search methods

An electronic database search of MEDLINE, Cochrane Central Register of Controlled Trials (CENTRAL), and EMBASE was performed (search strategy in Supplemental Material 1). No dates or language restrictions were applied. In addition, we also searched OpenGrey, experts' knowledge and screened the reference list of included studies or other relevant publications. The search was performed on the 2nd of November of 2020 and updated on the 20th of September of 2021.

Study selection, data collection process, and data items

As for the data extraction, two reviewers independently screened the titles and abstracts retrieved through the electronic search. Discrepancies were delt with a consensus-based discussion between the two authors. The reports that met criteria or were unclear were assessed through full text. The reasons for the exclusion of articles in this stage were recorded. In the case that the same study was published in different articles and the relevant data did not differ between the articles, we included the most recent publication. The data were extracted from the individual studies into a pre-piloted form.

Geometry of the network

A network plot of all studies was generated in which nodes represent the different screening interventions (systematic screening and opportunistic screening) and usual care, and lines connecting the nodes represent the direct head-to-head comparisons between interventions. The size of each node and the thickness of each line connecting the nodes are proportional to the number of studies.

Risk of bias within individual studies

The risk of bias in the included studies was assessed independently by the two authors using Cochrane Risk of Bias Tool [27] (RoB 2 and RoB 2 for cluster randomized trials). Discrepancies were also delt with a consensus-based discussion between the two authors.

Statistical analysis

Initially, we performed a random-effects meta-analysis of direct data retrieved from the included studies using R. We used a random-effects model to pool data owing to the anticipated heterogeneity in the included trials, in particular

differences in systematic screening design used in the different studies. We reported pooled dichotomous data using risk ratios (RRs) reporting 95% CIs and corresponding p values.

We assessed statistically the presence of heterogeneity within each pairwise comparison for the primary outcomes using the I^2 statistic.

To check the assumption of consistency in the entire network, we used the random-effects design-by-treatment interaction model. Using this approach, we inferred about the presence of inconsistency from any source in the entire network based on a Chi^2 test.

For dichotomous outcomes, assuming the transitivity and consistency of the data, we performed a random effects model frequentist NMA. In this method, we aimed to evaluate simultaneously all the available strategies regarding atrial fibrillation screening. We performed a network meta-analysis for the outcomes reported in an intention to screen analysis.

We used the Grading of Recommendations, Assessment and Evaluation (GRADE) framework to assess the overall quality of evidence. The certainty in the evidence for each outcome was graded as high, moderate, low or very low. We presented the overall quality of the evidence, using GRADE criteria, for the review outcome reported in an intention to screen in a table of summary of findings.

We performed sensitivity analysis for the following: studies at a high risk of bias; studies not excluding patients with previously diagnosed atrial fibrillation; studies that did not report the number of patients with previous atrial fibrillation diagnosis when these patients were not excluded from the study; studies that only reported the number of atrial fibrillation diagnosis in proportions; studies not excluding patients younger than 65 years of old; randomisation unit (individual versus cluster); according with type of screening tool used (12-channel ECG or single channel ECG).

Results

Included studies

The search returned 835 records, resulting in 656 records after removing duplicates. A further 58 records were retrieved from manual searching of reference lists.

After title and abstract screening, 30 articles were assessed for full-text screening, of these nine were included for qualitative and quantitative syntheses. (Fig. 1; details of excluded studies at Supplemental Material 2).

The main characteristics of the included studies [23, 28–35] are depicted in Table 1 and Supplemental Materials 3

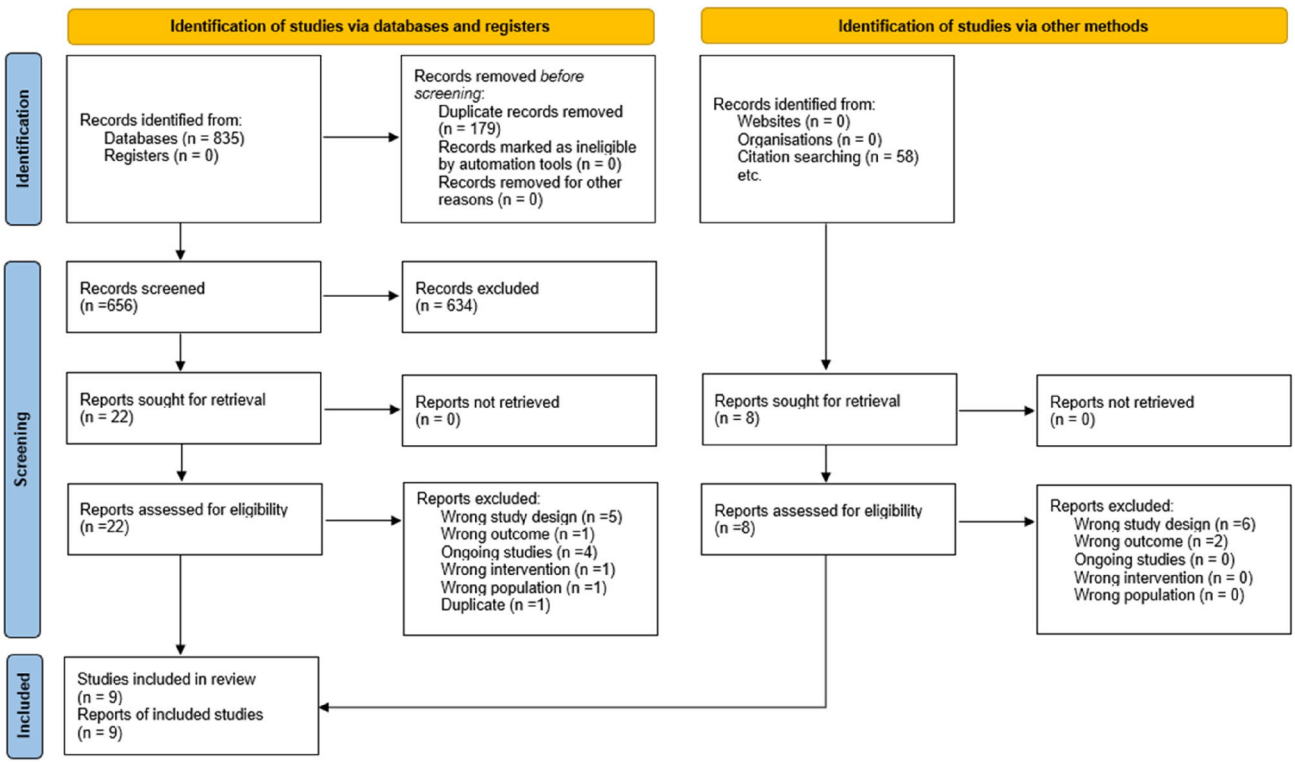


Fig. 1 Study flow diagram

Table 1 Characteristics of the included studies

Study and year	Region	Design	Characteristics of the participants of the included studies	Important outcomes evaluated	Population	Intervention	Comparator	Follow-up	Sample size required in each arm
Marco Mancinetti 2021	Switzerland	Randomised controlled trial	Patients admitted to the internal medicine ward without a previous diagnosis of AF	Incidence of new-onset AF	• UC: 423 people (41% women), MA 64.57 years • SyS: 381 people (43% women), MA 66.16 years	Systematic screening at multiple times in hospital setting	Routine care	NR	800
David j. Gladstone 2021	Canada and Germany	Multicentre randomized clinical trial	Patients aged 75 years or older with hypertension and without known AF	AF detected by cECG monitoring or clinically	OpS: 422 people (55,0% women), MA 80.1 years SyS: 434 people (58,8% women), MA 79.8 years	Continuous systematic screening in mixed settings (clinic plus outpatient)	Routine care	6 months	390
Emma Svennberg 2021	Sweden	Multicentre, parallel group, unmasked, randomised controlled trial	Patients aged 75 or 76 years	Detection of atrial fibrillation	• UC: 13,996 people (54,6% women), MA 76.0 years • SyS: 13,979 people (54.6% women), MA 76.0 years	Systematic screening at multiple times in ambulatory setting	Routine care	Minimum of 5 years	11,397
Steven B Uittenbogaart 2020	Netherlands	Cluster randomised controlled trial	Patients, aged 65 or older, with no AF	Difference in the rate of new AF diagnosis	• UC: 9526 people (54.3% women), MA 75.0 years • OpS: 9218 people (55.0% women), MA 75.2 years	Opportunistic screening	Routine care	1 year	8076
Kaasenbrood F 2020	Netherlands	Cluster randomised controlled trial	Patients, aged 65 or older, with no AF	Difference in the rate of new AF diagnosis	• UC: 8526 people (54.1% women), MA 74.5 years • OpS: 8581 people (54.5% women), MA 74.3 years	Opportunistic screening	Routine care	1 year	5000

Table 1 (continued)

Study and year	Region	Design	Characteristics of the participants of the included studies	Important outcomes evaluated	Population	Intervention	Comparator	Follow-up	Sample size required in each arm
Julian Halcox 2017	Wales	Randomised controlled trial	Patients aged 65 years or older with a CHADS-VASc ≥ 2, without AF	Detection of atrial fibrillation	• UC: 501 people (55% women), MA 72.6 years • SyS: 500 people (52% women), MA 72.6 years	Systematic screening at multiple times in mixed settings (clinic plus outpatient)	Routine care	12 months	500
Luisa Benito 2015	Spain	Randomised controlled clinical study	Patients without a diagnosis of AF but with one or more of: 65 years or older, AHt, IHD, VHD, Db, and/or CHF	Proportion of patients with newly diagnosed AF	• UC: 465 people (51% women), MA 69 years • SyS: 463 people (51% women), MA 69 years	Systematic screening at multiple times in a clinic setting	Routine care	2 years	458
Fitzmaurice 2007	England	Multicentred cluster randomised controlled trial	Patients 65 years or older. Patients who had died, were terminally ill or had moved away were replaced by random sample	number of new cases of AF	• UC: 4936 people (57,9% women), MA 75.5 years • SyS: 4933 people (57% women), MA 75.2 years • OpS: 4933 people (57.3% women), MA 75.1 years	• Opportunistic screening • Systematic screening at a single time in a clinic setting	Routine care	12 months	5000
Morgan S. 2002	England	Randomised controlled trial	Patients aged 65 to 100 years	To compare systematic screening and opportunistic case finding of AF	• OpS: 1502 people (58.9% women), MA 75.6 years • SyS: 1499 (58.6% women), MA 75.3 years	Systematic screening at a single time in a clinic setting	Opportunistic screening	6 months	1500

AF atrial fibrillation, *AHt* arterial hypertension, *CHF* congestive heart failure, *Db* Diabetes, *ECG* electrocardiogram, *IHD* ischaemic heart disease, *MA* mean age, *NR* not reported, *OpS* opportunistic screening, *SyS* systematic screening, *UC* usual care, *VHD* valvular heart disease

and 4. The sample sizes ranged from 804 to 24,490 patients, with a total of 80,665 patients included in our review.

Risk of bias

We judged two [28, 34] of the six RCTs to be at a high overall risk of bias, one [28] due to a high risk of randomization process bias, and the other [34] due to a high risk of measurement of the outcome bias. One [32] of the three cluster randomized clinical trials was at a high overall risk of bias due to a high risk of deviations of intended interventions. Supplemental Material 5 and Supplemental Material 6 summarise the results of risk of bias assessment using Cochrane Risk of Bias Tool RoB 2 and RoB 2 for cluster randomized trials, respectively.

Intention to screen analysis

Presentation of network structure

See Fig. 2.

Summary of network geometry

Nine studies (82-arm [23, 28, 30–35] and one multi-arms [29] studies) with a total of 80,665 patients were included in the network, with 36,612 of these patients included in the usual care group, 23,894 in the opportunistic screening group and 20,159 in the systematic screening group. Usual care was the most frequently investigated strategy (eight of the nine trials). There were three possible pairwise comparisons, with direct data available for all of them.

Atrial fibrillation diagnosis

Pooled effect sizes from the network meta-analysis suggested that systematic screening was effective for detecting atrial fibrillation when compared with usual care (risk ratio (RR) 2.11; 95% confidence interval (CI) 1.48–3.02) (Fig. 3) (Table 2). According to GRADE, the quality of evidence was rated as high for the comparison of systematic screening versus usual care (Supplemental Material 10).

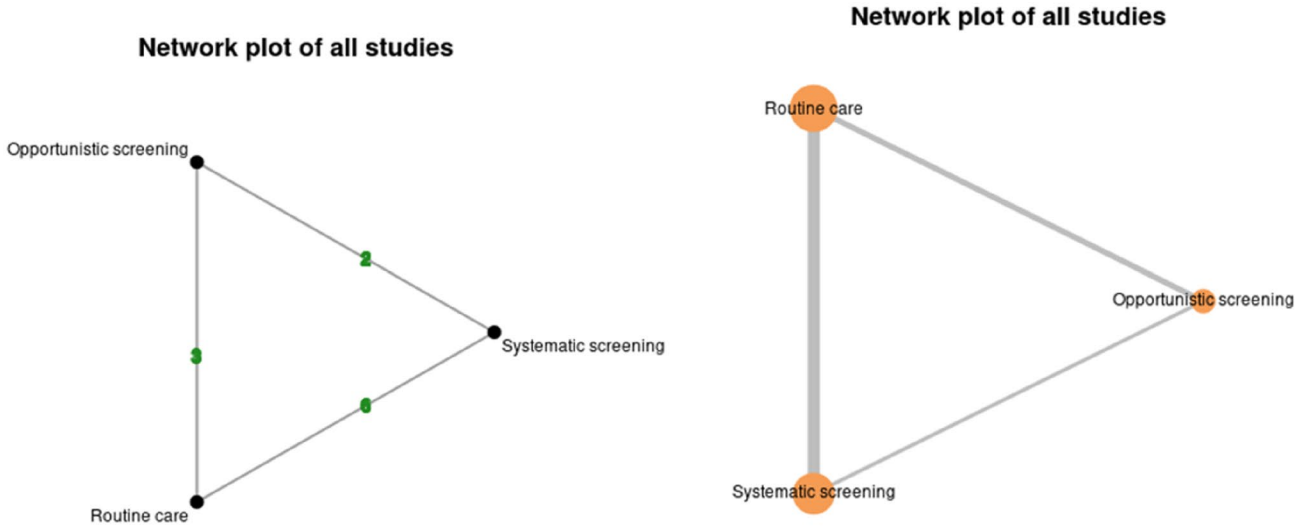


Fig. 2 Network plot for detection of atrial fibrillation in intention to screen analysis. Nodes represent the different screening interventions and usual care, and lines connecting the nodes represent the direct head-to-head comparisons between interventions. The size of each node and the thickness of each line connecting the nodes are proportional to the number of studies. Numbers on the lines represent the number of trials

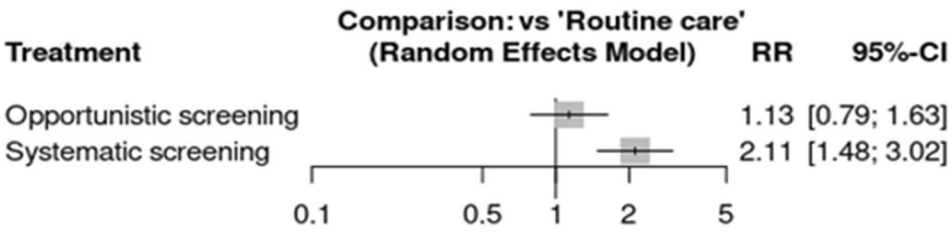


Fig. 3 Forest plot with relative risk ratios and 95% CIs from network meta-analysis for detection of atrial fibrillation compared with routine care in intention to screen analysis

Table 2 Treatments are ranked from best to worst along the leading diagonal

Systematic screening	1.72 [1.01; 2.92]	2.02 [1.37; 2.98]
1.86 [1.23; 2.82]	Opportunistic screening	1.19 [0.80; 1.78]
2.11 [1.48; 3.02]	1.13 [0.79; 1.63]	Routine care

Above the leading diagonal are estimates from pairwise meta-analyses, below the leading diagonal are estimates from network meta-analyses. Relative treatment effects in ranked order for all studies

No significant difference was found for the detection of atrial fibrillation between opportunistic screening and usual care (RR 1.13; 95% CI 0.79–1.63) (Fig. 3) (Table 2). According to GRADE, the quality of evidence was rated as low for the comparison of opportunistic screening versus usual care (due to risk of bias of included studies and imprecision) (Supplemental Material 10).

Systematic screening was more effective for detecting atrial fibrillation when compared with opportunistic screening (RR 1.86; 95% CI 1.23–2.82) (Table 2). According to GRADE, the quality of evidence was rated as high for the comparison of systematic screening versus opportunistic screening (Supplemental Material 10).

There was moderate heterogeneity in the comparisons between systematic screening and usual care and between opportunistic screening and usual care and high heterogeneity in the comparison between systematic screening and opportunistic screening (Supplemental Material 7).

There was no evidence of global inconsistency ($P=0.068$) or local inconsistency (Supplemental Material 8).

Sensitivity analysis are reported in Supplemental Material 9.

Discussion

Our main findings were that systematic screening was more effective in detecting atrial fibrillation than usual care or opportunistic screening in individuals aged 65 years or older. The quality of evidence for these conclusions was high. We did not find a statistically significant difference for the detection of atrial fibrillation between opportunistic screening and usual care. Yet, we considered the quality of evidence for this comparison to be low due to risk of bias of the included studies and imprecision in the results. As for the relative treatment effects ranking, systematic screening was the highest ranked strategy in every analysis and opportunistic screening and usual care were the second and third ranking strategies, respectively, in every analysis except in the sensitivity analysis excluding cluster randomized controlled trials in which usual care was ranked second and opportunistic screening was ranked third.

Screening interventions are designed to identify conditions which could at some future point turn into disease, thus enabling earlier intervention and management in the hope to reduce mortality and suffering from a disease [36–38]. In this way, early recognition of atrial fibrillation with appropriate anticoagulation could diminish the hospitalisation, morbidity and mortality associated with stroke [4]. Furthermore, early diagnosis of AF could have an impact on the prevention of other outcomes associated with AF such as ventricular dysfunction, heart failure, depression, cognitive decline and dementia.

Additionally, considering that the costs associated with patients with non-diagnosed atrial fibrillation are superior to those of patients with similar traits without atrial fibrillation, strategies to identify and treat patients with non-diagnosed atrial fibrillation could lead to significant costs reduction [20]. In fact, a study conducted in the UK concluded that the implementation of opportunistic screening, both for all individuals aged 65 years or older and only for individuals in this age group classified as being at high risk, would lead to a reduction in atrial fibrillation related stroke costs, with annual stroke-related costs being reduced by £394 m in 2020 (if screening the entire population aged 65 years or older) or by £46 m (if screening the population classified as being at high risk). The authors also note that as the prevalence of AF is expected to increase in the coming years, the cost savings through screening and treatment of AF are also expected to be greater in the future [39]. With this in mind, screening for atrial fibrillation could prove to be a beneficial measure.

Current guidelines, including the 2020 ESC and 2021 APHRS guidelines, recommend opportunistic screening via pulse palpation (followed by an ECG confirmation) or an ECG rhythm strip for patients aged 65 years and older (class 1 and level 1 recommendation in ESC and APHRS guidelines, respectively) and that systematic screening should be considered in individuals aged 75 years and older or with high risk of stroke (class 2A and level 2 recommendation in ESC and APHRS guidelines respectively) [40, 41]. However, this has recently been called into question by two studies [23, 32] in the Netherlands that report that opportunistic screening is no more effective than usual care in detecting atrial fibrillation in individuals aged 65 years or older. Furthermore, there seems to be no consensus on which is the most effective screening strategy (opportunistic or systematic) to detect atrial fibrillation in individuals aged 65 years or older.

A systematic review [42] performed in 2017 states that both opportunistic and systematic screening were more effective than usual care, but that systematic and opportunistic screening have similar efficacy. This systematic review also states that both opportunistic and systematic screening would probably be cost-effective when compared with usual care. However, given that the authors concluded that

systematic screening was no more effective than opportunistic screening and given that the costs associated with systematic screening are higher than the costs associated with opportunistic screening, they concluded that opportunistic screening was likely to be more cost-effective than systematic screening. However, this review only includes five studies and data were collected from only two of these studies and only one of these reported the number of people with atrial fibrillation at baseline, so conclusions were mainly based on that study.

The available evidence comparing the cost-effectiveness of systematic screening with opportunistic screening comes from the SAFE study conducted in 2005, which only considered systematic screening at a single point in time using a 12-lead ECG. However, new screening strategies have been developed since then, largely due to advances in technology. It is now possible to perform screening using cheaper tools (e.g., one lead ECG) intermittently on multiple occasions or even continuously, allowing for increased screening efficacy in detecting AF (especially paroxysmal AF and de novo AF). Therefore, there is a need for further studies that take these strategies in to account to conclude whether systematic screening is currently a cost-effective measure to be implemented in the clinic when compared to opportunistic screening.

Another systematic review [24] performed in 2019 reports that both opportunistic and systematic screening were more effective than usual care in detecting previously undiagnosed atrial fibrillation in patients aged 40 years or older, but subgroup analyses showed superiority of systematic screening over opportunistic screening. The authors also report that, when performing subgroup analyses using an age cut-off of 65 years or older, they found no differences in the efficacy of screening when compared with screening using lower age cut-offs (40 years). However, this review was based mainly on observational studies and of the 25 studies included in the meta-analysis, only 3 were RCTs.

Through our network meta-analysis, we determined that systematic screening is more effective than either usual care or opportunistic screening. This was expected since both usual care and opportunistic screening only allow for assessment of patients who come to health care on their own initiative, whereas in systematic screening the individuals who constitute the target population of the screening are identified in order to be directly invited for screening. In addition, another reason why both systematic and opportunistic screening would be expected to be more effective in identifying individuals with atrial fibrillation than usual care is that in usual care only the heart rhythm of those individuals in whom there is a previous suspicion of atrial fibrillation is determined, whereas in systematic screening and opportunistic screening the heart rhythm of all individuals belonging to the screening target population is evaluated, and these individuals do not necessarily need to present signs or symptoms of atrial fibrillation. However, surprisingly, the results of our network meta-analysis did not demonstrate a statistically significant difference between the effectiveness of opportunistic screening and usual care in detecting atrial fibrillation. As mentioned above, the quality of evidence for this conclusion is low due to risk of bias of the included studies and imprecision of the results. The risk of bias of the included studies comes from the Kaasenbrood et al. [32] as there was a high risk of bias due to deviations from the intended intervention, and the authors mention that some participants underwent screening, but as they did not sign the informed consent, they were not included in the results as having undergone screening. The authors do not specify in how many cases this happened, so it cannot be excluded that this affected the results.

Our network meta-analysis provides the relative effectiveness of atrial fibrillation detection strategies in a coherent and methodologically robust way by combining both direct (which was available for all comparisons) and indirect evidence from RCTs, thus increasing the statistical power and confidence in the results. We were thorough in our evaluation of the important potential treatment effect modifiers (minimum age for inclusion; minimum CHADS-VASc score for inclusion; heart rhythm at baseline; study setting; strategy for implementation of screening). We did not encounter important differences in the distribution of the effect modifiers between the different comparisons. No inconsistency was found in the results of the network meta-analyses. As for the sensitivity analyses, if we exclude the studies with high risk of bias, the difference between systematic screening and opportunistic screening ceases to be statistically significant, although systematic screening remains higher in the ranking. If we exclude the study that did not report the number of patients with previously diagnosed atrial fibrillation the difference between systematic screening and opportunistic screening also ceases to be statistically significant. If we consider only the cluster randomized controlled trials, there is no longer a statistically significant difference between any of the strategies, although the ranking remains with systematic screening in first place, opportunistic screening in second place and usual care in third place. If we exclude cluster randomised controlled trials, usual care is ranked second and opportunistic screening is ranked third, although there is still no statistically significant difference between these two interventions. We believe that the differences between the results of the main analysis and these sensitivity analyses are mainly due to the loss of statistical power associated with the decrease in the sample included in the sensitivity analyses. The results remained unchanged in the remaining sensitivity analyses.

As for the quality of the evidence, we did not downgrade the estimates from the network meta-analysis comparing

systematic screening with usual care and with opportunistic screening. However, we downgraded the estimates from the comparison between opportunistic screening and usual care due to risk of bias from the included studies. We also downgraded the estimates from the comparison between opportunistic screening and usual care due to imprecision in the results, since the 95% confidence interval overlaps no effect and fails to exclude important benefit. There was no imprecision in the results from the comparison between systematic screening and usual care and between systematic screening and opportunistic screening. There was no indirectness or inconsistency in the results of any of the comparisons.

Study populations differed in several aspects (minimum age for inclusion, minimum CHADS-VASc score for inclusion, previously known atrial fibrillation and study setting). This heterogeneity of the populations included may have influenced the results, as some populations had more risk factors for developing atrial fibrillation. We found moderate heterogeneity in the comparisons between systematic screening and usual care and between opportunistic screening and usual care and found high heterogeneity in the comparison between systematic screening and opportunistic screening. Other potential bias and limitations are mentioned in the supplemental material 11.

Conclusions

Systematic screening is the most effective strategy for detecting atrial fibrillation in individuals aged 65 years or older. Although systematic screening is the most effective strategy for identifying atrial fibrillation, more studies need to be done to determine whether this strategy is cost-effective before its implementation in clinical practice can be recommended, as this analysis was not the target of our study.

Opportunistic screening is no more effective than usual care in detecting atrial fibrillation in individuals aged 65 years or older, but the results were weakened by a low quality of evidence.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s00392-022-02117-9.

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Declarations

Conflict of interest Daniel Caldeira has participated in educational meetings and/or attended conferences or symposia (including travel, accommodation, and/or hospitality) with Bristol-Myers Squibb, Bayer, Boehringer Ingelheim, Daiichi Sankyo, Merck Serono, Ferrer, Pfizer, Novartis, and Roche. The remaining authors do not have interests to disclose.

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