BMJ Open

# Feasible approaches and implementation challenges to atrial fibrillation screening: a qualitative study of stakeholder views in 11 European countries

Daniel Engler ,[1,2] Coral L Hanson ,[3] Lien Desteghe,[4,5,6,7] Giuseppe Boriani ,[8] Søren Zöga Diederichsen ,[9] Ben Freedman ,[10,11,12] Elena Palà,[13] Tatjana S Potpara ,[14,15] Henning Witt,[16] Hein Heidbuchel,[5,6,7] Lis Neubeck,[3,17] Renate B Schnabel ,[1,2] for the AFFECT-EU investigators

**To cite:** Engler D, Hanson CL, Desteghe L, *et al*. Feasible approaches and implementation challenges to atrial fibrillation screening: a qualitative study of stakeholder views in 11 European countries. *BMJ Open* 2022;**12**:e059156. doi:10.1136/bmjopen-2021-059156

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (http://dx.doi.org/10.1136/bmjopen-2021-059156).

Received 10 November 2021
Accepted 25 May 2022



For numbered affiliations see end of article.

**Correspondence to**
Daniel Engler; d.engler@uke.de

## ABSTRACT

**Objectives** Atrial fibrillation (AF) screening may increase early detection and reduce complications of AF. European, Australian and World Heart Federation guidelines recommend opportunistic screening, despite a current lack of clear evidence supporting a net benefit for systematic screening. Where screening is implemented, the most appropriate approaches are unknown. We explored the views of European stakeholders about opportunities and challenges of implementing four AF screening scenarios.

**Design** Telephone-based semi-structured interviews with results reported using Consolidated criteria for Reporting Qualitative research guidelines. Data were thematically analysed using the framework approach.

**Setting** AF screening stakeholders in 11 European countries.

**Participants** Healthcare professionals and regulators (n=24) potentially involved in AF screening implementation.

**Intervention** Four AF screening scenarios: single time point opportunistic, opportunistic prolonged, systematic single time point/prolonged and patient-led screening.

**Primary outcome measures** Stakeholder views about the challenges and feasibility of implementing the screening scenarios in the respective national/regional healthcare system.

**Results** Three themes developed. (1) Current screening approaches: there are no national AF screening programmes, with most AF detected in symptomatic patients. Patient-led screening exists via personal devices, creating screening inequity. (2) Feasibility of screening: single time point opportunistic screening in primary care using single-lead ECG devices was considered the most feasible. Software algorithms may aid identification of suitable patients and telehealth services have potential to support diagnosis. (3) Implementation requirements: sufficient evidence of benefit is required. National screening processes are required due to different payment mechanisms and health service regulations. Concerns about data security, and inclusivity for those without primary care access or personal devices must be addressed.

**Conclusions** There is an overall awareness of AF screening. Opportunistic screening appears the most feasible across Europe. Challenges are health inequalities, identification of best target groups for screening, streamlined processes, the need for evidence of benefit and a tailored approach adapted to national realities.

## STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ Telephone interviews were conducted by members of a multilingual research group, allowing engagement with a diverse sample of healthcare professionals and regulators from 11 European countries.
⇒ This study focuses on process considerations for implementation of atrial fibrillation (AF) screening to understand whether AF screening can work in practice and how, because if ongoing studies and individual patient meta-analyses provide strong evidence for screening, it is important to have already considered implementation strategies.
⇒ Purposive sampling was used to invite potential participants who were knowledgeable about or influential in decisions about AF screening, and those who responded may have been biased in favour of screening.

## INTRODUCTION

Atrial fibrillation (AF) is the most common arrhythmia of clinical importance in the general population worldwide.[1] The prevalence rises to >1 in 10 in older adults.[2] Due to rapid ageing in the population and survival from underlying conditions closely related to AF, recent projections indicate that the prevalence will more than double in the next decades.[3–5] AF is therefore very likely to impose a substantial and growing economic and societal burden on the different healthcare systems across Europe. Importantly, compared with individuals free of AF, the presence of stroke in individuals with AF is

nearly fivefold higher[6] and one-tenth of patients who have an ischaemic stroke are first diagnosed with AF at the time of the stroke event.[7] Currently, the initial diagnosis of AF is often related to symptoms that lead to rhythm monitoring. However, AF often is paucisymptomatic or asymptomatic.[8] Detection of AF by screening before symptoms or complications occur, could initiate treatment with oral anticoagulants to reduce the risk and the severity of stroke.[1 9] Opportunistic screening for AF by pulse taking or ECG in patients ≥65 years of age or systematic ECG screening in aged individuals ≥75 years, or those at high risk, is recommended by the European Society of Cardiology (ESC).[1] Despite these recommendations, whom and how to screen and the optimal setting with the highest efficiency remain uncertain among experts.[10] There is ongoing controversy about cost-effectiveness and a lack of evidence about AF screening.[11] Based on the lack of evidence from randomised studies on the stroke reduction efficacy of systematic AF screening and on the lack of data on stroke risk of shorter asymptomatic AF episodes, the United States Preventive Services Task Force have given an 'I' recommendation (inadequate evidence) for AF screening.[11] Consequently, appropriate risk-based screening and systematic screening programmes at a comprehensive national healthcare level do not currently exist in any of the European countries nor in the USA. However, in the near future, data from ongoing studies and individual patient meta-analyses will enrich our insights into the merits and pitfalls of the AF screening process.

A range of new technologies has been developed that may improve the feasibility, accuracy and rates of AF detection.[12] However, the best approach to AF screening remains uncertain. In this study, we undertook semi-structured interviews with experts in the field including various healthcare professionals (HCP) and regulatory authorities in order to identify obstacles and opportunities of different possible AF screening scenarios across Europe.

## Methods

This qualitative study used semi-structured telephone interviews to explore the feasibility of different approaches to screening for primary detection of AF across 11 European countries. Results were reported using the Consolidated criteria for Reporting Qualitative research guidelines.[13] Overarching themes, encompassing current practice, the feasibility of the different AF screening approaches and implementation requirements were established.

### Patient and public involvement

Patients and the public were not involved in the choice of topic, assisting in the study design, advising on the project or in carrying out the research.

### Sample

We recruited a purposive sample of key informants,[14] who were identified of as being knowledgeable about AF and/or influential in the implementation of health screening policies across 11 European countries via a panel of AF experts involved in the EU-funded AFFECT-EU (affect-eu.eu),[15] Digital, Risk-based Screening for Atrial Fibrillation in the European Community study between June and May 2021. Eligible participants were (i) HCP with experience in screening and clinical expertise in AF detection and management (nurses, general practitioners, pharmacists, cardiologists); (ii) regulators (individuals with insights into processes for the implementation of disease screening programmes, developing health technology assessments for political decision-making or with expertise of reimbursement procedures and detailed knowledge of (cost)-effectiveness of screening programmes). Email invitations explaining the aim of the study and that the research/researchers were part of a wider pan-European project about AF screening, were sent to potential participants (n=40). Participants gave consent to register for the study.

### Data collection

The AFFECT-EU research group developed two interview guides, one for each professional group. We used an iterative process of expert review and with reference to AF screening literature. Topics included current national approaches to AF screening, other national disease screening programmes and discussion about four AF screening scenarios (figure 1) developed specifically for the interview guide: single time point opportunistic screening, prolonged opportunistic screening, systematic single time point or prolonged screening and patient-led screening (online supplemental file 1). We defined opportunistic screening as any screening programme that did not systematically invite patients or members of the public to take part (eg, screening a patient in primary care while they were attending an appointment for another reason, or a member of the public shopping at a pharmacy and being offered the opportunity to take part in AF screening).

Lead experts in the field (RS, HH) guided the development of the scenarios and the interview questionnaire. Six researchers (DE, CLH, LD, GB, EP, TSP), arranged interviews in their country of residence and conducted telephone interviews at convenient times for participants in their native language. In countries with no resident researcher, interviews were conducted in English. Prior to interviews, participants were provided with the questions and visual representations of the four screening scenarios. Interviews took place between July 2020 and May 2021 with consistent application of the interview guide. Interviews were conducted in private, recorded on an encrypted audio recorder and transcribed verbatim. All transcripts were translated into English by the researcher who conducted the interview.

### Data analysis

Interview transcripts were imported into NVivo V.12 (QSR International, Melbourne, Australia) for analysis and

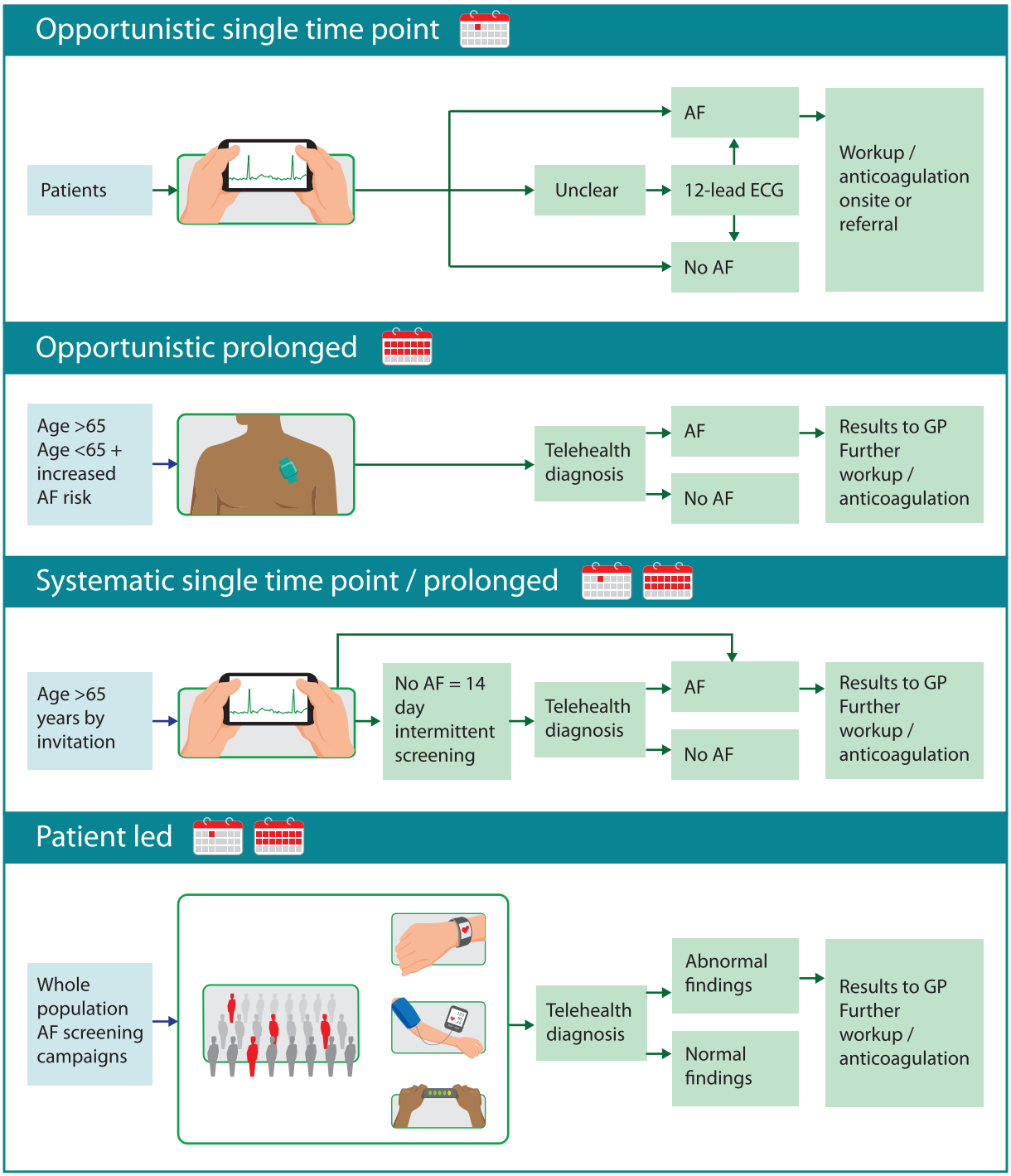


**Figure 1** Atrial fibrillation (AF) screening programmes: current approaches, feasibility and implementation challenges. GP, general practitioner.

used a unique identification code to protect participant identities. Data were analysed using thematic analysis[16] with a framework approach.[17] One researcher (CLH), a research fellow with 8 years' experience of qualitative research, read and re-read all transcripts in the familiarisation phase. She independently created open codes (n=53) identifying relationships, similarities or dissimilarities for the first three transcripts. During identification, CLH presented data at a workshop, with four other researchers, one male and three females (DE, LD, LN and RS) acting as 'critical friends' to provide critical input and outline sources of bias. In our initial framework, we identified 10 categories (current approaches to screening, evidence of effectiveness, feasibility of AF screening, screenee identification, screening location, timing, use of technology, interpretation of screening results, potential inequity and remuneration). During indexing, CLH coded six more transcripts. LN, a professor with 10 years' experience of qualitative research, checked coding and category accuracy before CLH and DE coded all remaining transcripts.

Table 1 Participant characteristics

| Characteristic | Profession and country | N | % |
|---|---|---|---|
| Stakeholder | Healthcare professional (cardiologist, general practitioner) | 13 | 54.2 |
| | Regulator | 11 | 45.8 |
| European area | Nordic countries (Sweden, Denmark and Norway) | 5 | 20.8 |
| | Central and northern Europe (Scotland, Belgium, France and Germany) | 10 | 41.7 |
| | Eastern and southern Europe (Spain, Poland, Italy and Serbia) | 9 | 37.5 |

In a second workshop with all researchers, we explored and rearranged the data according to the themes and compared these within and across all cases. Prior to final analysis, five researchers (CLH, DE, LD, LN and RS) reviewed the framework and agreed to 3 final overarching themes and 10 subthemes.

## RESULTS

We recruited 24 participants from 11 European countries (table 1). Sixteen people who were invited to take part did not respond to the invitation email. Median interview length was 54 (range 36–78) min.

Three main themes developed: (1) current approaches to screening, (2) the feasibility of AF screening approaches and (3) implementation requirements (figure 2). We present data in tables that summarise participants' views of the status within each theme and how these relate to the opportunities and challenges for future AF screening programmes across Europe. Indicative quotes are provided.

### Current approaches to screening

The majority of AF detection currently takes place in primary care when patients present with symptoms, during workup for other conditions or during a routine follow-up consultation. Those who do not routinely visit healthcare services are excluded from potential detection of AF. National screening programmes exist across all 11 European countries for various cancers and some cardiovascular diseases. Many participants considered that AF screening could be integrated into cardiovascular check-ups (eg, systematic screening of blood pressure, body mass index and lifestyle factors or opportunistic approaches to screening these factors) but not into current cancer screening programmes. The latter was because of the inappropriate age of those screened (cervical cancer) or remote sample collection (bowel cancer). Population awareness-raising programmes exist for lifestyle (smoking, physical activity and diet) and some cardiovascular diseases but only in exception for AF. Participants reported that these programmes increased health inequalities (table 2).

### The feasibility of AF screening approaches

There was some support for all screening scenarios, but participants considered that single time point opportunistic AF screening using single-lead ECG devices was the most appropriate and feasible approach if proven effective.

Some of the participants stated that software systems in primary care had the potential to identify suitable patients for screening but that algorithms did not currently exist for this. Telehealth centres were reported to be a potential solution to support ECG interpretation and AF training, although there were conflicting views about where such a service should be located. Participants in central, northern and Nordic areas of Europe suggested that patients who are more affluent increasingly present with potential AF diagnoses from privately owned wearables, creating pressure for medical investigations, data protection issues and increasing health inequalities (table 3).

### Implementation requirements for AF screening

Primary care was considered the most appropriate location for AF screening by the majority of participants, with mixed views about the suitability of pharmacies. Participants reported that GPs could be relieved of some of the burden for AF screening with alternative staff training. Most participants agreed that there was a need for advocates for national AF screening programmes who must present evidence of effectiveness and produce clear protocols for implementation to national review committees in order to build a case for screening. Where screening is introduced, country/local payment mechanisms must be agreed (table 4).

## DISCUSSION

This study explored the views of 24 expert HCP and regulators across Europe about the opportunities and challenges of AF screening implementation and on four specific AF screening scenarios using thematic analysis. Three major themes developed that are related to opportunities and challenges for AF screening: (1) current approaches to screening, (2) the feasibility of AF screening approaches and (3) implementation requirements. Our study participants reported that AF is mainly diagnosed via symptomatic patient presentation in primary care across all the European countries involved. Structured approaches for AF screening on a national or regional level (besides research projects) do not exist. There is a perceived need to implement AF screening; however, the participants considered a lack of evidence for effectiveness as the main barrier to implementing AF


**Figure 2** Opportunities and challenges for the implementation of atrial fibrillation (AF) screening in Europe.

**Table 2** Current approaches to screening

| Topic | Current status | Indicative quotes | Opportunities/Challenges for implementation | Indicative quotes |
|---|---|---|---|---|
| AF detection | The majority of detection is in primary care during:<br>► symptomatic patient presentation<br>► medical review for other conditions<br>► opportunistic pulse palpitation during blood pressure checks (inconsistent) | *'Patients are mostly detected when they have some symptoms and present themselves at a physician'. (Participant 2, HCP)* | Individuals who do not routinely visit primary care are excluded from current opportunistic AF screening opportunities, and would benefit from a more systematic approach of screening. | *"If you only observe the persons who come to the GP, you could possibly miss the most vulnerable ones". (Participant 3, regulator)* |
| | Incidental detection occurs in secondary care during workup for other diseases:<br>► preoperative ECGs<br>► emergency department visits or secondary diagnosis for unrelated condition<br>► investigation after cryptogenic stroke | *'Patient attends the outpatient clinic, the emergency department or another HCP for any other problem and AF is detected (eg, ECG before surgery)'. (Participant 23, regulator)* | | |
| National screening programmes | Systematic national screening programmes exist across Europe for cancer (eg, breast, bowel and cervical) but not for AF | *'There are a lot of screening programs: breast cancer and colon cancer screenings .... At the institutional level, AF screening campaigns have never been performed'. (Participant 22, regulator)* | Integration of AF screening with cancer screening programmes is generally not considered feasible. | *"Bowel screening is sent out in the post and the sample is sent back … Cervical screening—you are more targeting younger women". (Participant 18, regulator)* |
| | General cardiovascular healthcare check-ups exist in some countries, but have been discontinued in others due to unproven effectiveness | *'They did exist until a couple of years ago … it wasn't clear what the measurements and objectives were, so it was really difficult to show any solid improvement'. (Participant 18, regulator)* | Where cardiovascular healthcare check-ups exist, integration of AF screening is considered feasible. | *'The "health check", is an implemented directive and sets out details of the health examinations carried out by general practitioners for the early detection of diseases. … AF screening within this context is reasonable'. (Participant 10, regulator)* |
| | Where national AF screening has been considered (eg, UK, Sweden, Norway), it has been negatively evaluated due to lack of evidence about effectiveness | *'In 2015, the governmental authority evaluated the need of AF screening for the [country] health system. However, they did not see enough evidence to support a national screening programme due to lack of endpoint data'. (Participant 13, HCP)* | Further studies (including RCTs) are required to demonstrate the (cost-) effectiveness of different approaches to AF screening. | *"We don't have the data for systematic screening yet … There are some small signs in the STOPSTOKE study that it did reduce. But we need to prove it in larger scale". (Participant 6, HCP)* |

Continued

**Table 2** Continued

| Topic | Current status | Indicative quotes | Opportunities/Challenges for implementation | Indicative quotes |
|---|---|---|---|---|
| Population awareness programmes | National population-based promotion programmes exist more commonly in Nordic and northern/central European countries that target:<br>► lifestyle (eg, smoking, diet, physical activity)<br>► cardiovascular disease (eg, know your blood pressure or stroke recognition)<br>► in exception, a television campaign to encourage the use of a single-lead ECG device for patient-led AF screening | *'There are lots of things going on and anyone who walks into a GP surgery will see lots of leaflets from organisations such as [charity] about lifestyle, high blood pressure and various other things'. (Participant 16, HCP*) | If used, population-based awareness raising of AF and AF screening programmes should address health literacy issues, be wide-ranging and include:<br>► television, social media and internet-based promotion;<br>► newspaper advertising;<br>► patient leaflets in primary care and pharmacies;<br>► links to lifestyle modification information. | *'Smoking campaigns used TV advertising, newspaper and the public health initiated apps for quitting smoking … Quite a good system in authorities to implement large campaigns'. (Participant 13, HCP*)<br>*'Pharmacies also have a role in promoting healthy lifestyles and the detection of various conditions'. (Participant 16, HCP*) |
| | Population-based awareness campaigns are led by national health authorities, medical charities, patient organisations and, in exception, commercial entities<br>This type of screening may widen health inequalities because *'it works best for the more affluent'* | *'The national authority of health have campaigns related to smoking and alcohol and physical exercise and obesity'. (Participant 5, regulator*) | Raising AF awareness via publicity campaigns is not a screening programme and considered to have limited impact. There is a risk that such approaches do not reach those most in need. | *"A major drawback of this screening strategy is that you are going to reach the wrong patients". (Participant 1, HCP*) |

AF, atrial fibrillation; GP, general practitioner; HCP, healthcare professional; RCT, randomised controlled trial.

**Table 3** The feasibility of AF screening approaches

| Topic | Current status | Indicative quotes | Opportunities/Challenges for implementation | Indicative quotes |
|---|---|---|---|---|
| Appropriateness of AF screening approaches | Single time point AF opportunistic screening in primary care using a hand-held diagnostic device is considered the cheapest, most appropriate and feasible approach if proven effective<br>In primary care, systematic screening is considered too difficult due to extra:<br>► time to identify and invite patients<br>► appointment time | *'This type of screening [single time point opportunistic] could be implemented; it would be the easiest way'. (Participant 19, HCP)*<br>*'Specific visits for this [systematic screening] should be scheduled, this is a lot of work'. (Participant 21, HCP)* | Opportunistic single time point approaches targeting older age groups are more likely to be adopted as they:<br>► require less administrative effort;<br>► could be integrated with other programmes (eg, influenza vaccination);<br>► require little effort from patients.<br>Patients require education about the context/meaning of a negative result. | *"If a doctor or a nurse is giving a flu jab to a patient they will spend 20 or 30 seconds feeling the patients at the same time". (Participant 16, HCP)*<br>*'Single time point screening has a high probability of reassuring individuals if the test is negative, although this can be false negative'. (Participant 3, regulator)* |
| | Prolonged patch use is too expensive and difficult, except for in symptomatic patients or after cryptogenic stroke:<br>► Devices detect short paroxysms of AF but the highest risk is for prolonged episodes, casting doubt on the appropriateness of prolonged screening | *'This scenario (prolonged patch use) will be too expensive due to high cost of training and devices, for example, infrastructure to send the device back etc'. (Participant 8, regulator)* | If prolonged screening is implemented:<br>► it should target symptomatic or cryptogenic stroke patients;<br>► to increase patient compliance, the implications of prolonged device use must be explained cost-effectiveness must be assessed. | *'The target population needs to very well selected … Patients do not understand the procedure … this is the big problem with prolonged monitoring'. (Participant 21, HCP)* |
| | Patient-led screening:<br>► already exists<br>► could reach large numbers but may increase health inequalities | *"This is already reality. People screen themselves … send us a PDF file from their wearables". (Participant 24, HCP)*<br>*'Who would provide devices for those who need it, rather than those who are able to buy them?' (Participant 17, regulator)* | Alternative diagnostic strategies are needed to prevent pressure in primary care as the gatekeepers for diagnosis/investigation of potential false positives. | *"I am against this approach, which will lead to a higher number of false positives, requiring medical assistance even if not at risk of AF". (Participant 11, HCP)* |
| Interpretation of screening and follow-up | Where diagnosis is clear, treatment in primary care is appropriate<br>For unclear diagnoses, a 12-lead ECG is required but there is inequity in ECG machines provision in primary care | *"This is highly dependent on the individual physician. If he/she is confident to handle the ECG tracing, we can and will start anticoagulation if AF is detected". (Participant 7, HCP)* | Not all GPs are confident in ECG interpretation and may require external support.<br>More complex patients need further specialist review outside primary care. | *"I think our GPs are very well educated, but they have many diseases around … it [ECG] is not all the time well interpreted by them". (Participant 14, HCP)*<br>*'There is a guideline for GPs about referral to secondary care for ongoing symptoms, younger patients or difficult problems such as AF in the context of heart failure'. (Participant 16, HCP)* |

Continued

**Table 3** Continued

| Topic | Current status | Indicative quotes | Opportunities/Challenges for implementation | Indicative quotes |
|---|---|---|---|---|
| | Telehealth is viewed as:<br>► potentially positive but futuristic<br>► able to help interpretation of data, training and patient information needs<br>COVID-19 has accelerated the acceptance of remote/centralised services, but views differ on suitable providers | *'If strategies like this are implemented, that means a huge dataflow … healthcare does not have any resources to handle this'. (Participant 24, HCP*)<br>*'COVID has accelerated the acceptance of centralising and making some things remote'. (Participant 17, regulator*) | Most HCP are not convinced about the utility of telehealth for AF, but where used it should include:<br>► training for HCP;<br>► support for ECG interpretation.<br>Telehealth providers could be:<br>► in secondary care or public health delivered by a third party. | *'One of the reasons why there is no AF screening in [country] is because primary care physicians do not know a lot about ECGs … here tele-health can help'. (Participant 22, regulator*) |
| Use of technology | Single-lead hand-held devices are considered:<br>► easy to use, cheap and reliable | *"I have found the [handheld device name] to be very reliable, if it says definite AF, it is usually correct". (Participant 16, HCP*)<br>*"They can easily make a measurement with a handheld device". (Participant 1, HCP*) | Availability of devices is inequitable:<br>► Some European areas require initial investment to implement. | *'Obstacles are related to logistics and organization; the need to provide GPs with the single time point ECG tool, thus requiring an initial investment of the health care system'. (Participant 11, HCP*) |
| | For patient-led screening, wearable and hand-held devices are important, but a may create screening inequity | *'Digital literacy is a major problem'. (Participant 12, regulator*)<br>*'Detection bias based on socioeconomic status'. (Participant 23, regulator*) | Privacy and data transfer protocols must be developed for patients reporting results from personal devices.<br>High acquisition costs for self-detection devices may limit equitable screening. | *"There will be a lot of obstacles with regard of privacy and the use of private devices for health data. Let's say we have a patient using [device] and he/she wants to send us a PDF of AF. We are more or less not allowed to do the diagnoses". (Participant 13, HCP*) |

AF, atrial fibrillation; GP, general practitioner; HCP, healthcare professional.

**Table 4** Implementation requirements for AF screening

| Topic | Current status | Indicative quotes | Opportunities/Challenges for implementation | Indicative quotes |
|---|---|---|---|---|
| Location of screening | ► Primary care is the most appropriate location for AF screening | *'Primary care is the most applicable option'.* (*Participant 1, HCP*) | Short appointments in primary care mean that HCP may not prioritise AF screening without clear evidence of benefit. | *'GPs do not have time to do screening as only 7 minutes allocated for each patient'. (Participant 21, HCP*) |
| | There were mixed views about the suitability of pharmacies as a screening location because:<br>► pharmacists could easily be trained in the necessary screening skills<br>► pharmacies operate on a profit basis with a customer rather than a patient relationship, which may influence screening patterns | *'It would be easy for them [pharmacists] to learn to check pulses … how to use a hand held ECG'. (Participant 16, HCP*)<br>*"I do not think that involvement of pharmacies is appropriate they have a 'for profit' perspective". (Participant 12, regulator*) | If pharmacies are used for AF screening, protocols must be developed for screening processes, data storage and data transfer. | *"I am not quite sure what the data protection issues would be for pharmacist screening … the storing of the ECG and appropriate communication with the patient's GP about the results and so on". (Participant 16, HCP*) |
| | In exception, dentists and podiatrists were suggested as other suitable locations for AF screening | *'One possible is encouraging dental practices, while the patient is sitting in the chair for 10 minutes is to have those patients sitting with a device that records a single ECG'. (Participant 16, HCP*) | Dentists have registered patients; therefore data storage and transfer issues are less complex than community or commercial locations. | *'Patients tend to be registered in the same way that they are registered with a GP, and there could be communication between the dentist and patient's GP about the results'. (Participant 16, HCP*) |
| Personnel requirements | Primary care professionals (and allied HCP in other locations) require further training in:<br>► ECG interpretation<br>► patient education for AF | *'Sufficient education is also needed for the personnel who will perform this screening and inform the patients'. (Participant 1, HCP*) | Training should include:<br>► how, who and when to screen;<br>► advice for patients about the pros and cons of screening and treatment. | *'Screening could be implemented in [country] if nurses and GPs were educated how to screen for AF and how to explain the screening to patients'. (Participant 20, HCP*) |
| | Introducing AF screening in primary care would result in increased burden for already time-pressured GPs | *'The main barrier is that doctors do not have enough time per patient'. (Participant 20, HCP*) | Practice nurses or non-medically trained primary care employees could inform and guide the patient through AF screening using a single-lead device. | *"We should use everybody—every contact counts. Particularly in view of modern technology there doesn't need to be a lot of skill involved in the detection part". (Participant 17, regulator*) |

Continued

**Table 4** Continued

| Topic | Current status | Indicative quotes | Opportunities/Challenges for implementation | Indicative quotes |
|---|---|---|---|---|
| Regulatory requirements | For the implementation of national screening programmes, sufficient evidence of effect must be evaluated by national review committees | *'The implementation of screening depends on a positive vote of the [review committee] by the evaluation of the committee evidence based efficiency of the screening for the targeted population'. (Participant 10, regulator*) | Advocates for AF screening must present:<br>► clear guidance and protocols for screening;<br>► present evidence of effectiveness of screening and for *'quality standards, affordability and accessibility'* to national review committees. | *'Various considerations are taken into account: scientific evidence, European guidelines … health economic data, budget, budget, social acceptability, ensure high quality and organisational feasibility'. (Participant 3, regulator*) |
| | Where screening or interpretation is performed outside primary or secondary care environments, there are data protection issues that are not adequately addressed | *'Where would the data be stored? How safe the data will be protected in case of abroad storage?' (Participant 10, regulator*) | Where telehealth centres or community testing are implemented clear protocols for safe data transfer and storage are required. | *"If we act according to GPDR, then we are basically safe with regard to data protection". (Participant 5, regulator*) |
| Payment mechanisms | Reimbursement pathways vary across Europe:<br>► national, local and private payment mechanisms exist<br>► a pan-European approach to payment is impossible | *'Specificity in the [country] health care system… here it is based on national health funding'. (Participant 15, regulator*)<br>*'The majority of a patient's health insurance is centrally GP-based. GPs are paid on a combined capitation and fee-for-service'. (Participant 5, regulator*) | Even within countries, locally focused payment mechanisms may prevent a coordinated approach to the implementation of AF screening without a nationally regulated screening approach. | *'The new improvement framework for primary care is called "improving together"… it is less specific as to what is tackled—it is very much ground up—which makes it difficult to be prescriptive about anything'.* (*Participant 18, regulator*) |
| | Costs for telehealth provision is not covered by current reimbursement systems, creating a potential conflict between primary care and the creation of new service provision | *'Evaluation of AF by a tele-health provider is a structure that is not available … Costs could not be claimed within the current reimbursement structure'. (Participant 8, regulator*) | Upcoming screening trials should include a clear overview of the associated costs and cost-effectiveness. | *"Studies would be needed to prove that its use is cost-effective in order to convince the physicians and the authorities". (Participant 22, regulator*) |

AF, atrial fibrillation; GP, general practitioner; HCP, healthcare professional.

screening across the European healthcare systems. This is despite clear recommendations with class I/IIa evidence in the latest AF management guidelines.[1]

Previous AF screening studies have largely used non-randomised, cross-sectional study designs that render it difficult to compare AF detection with usual care in the same population.[18] Recent studies, some of them ongoing, applied more intensive screening approaches.[19–23] Assessment of Remote Heart Rhythm Sampling Using the AliveCor Heart Monitor to Screen for Atrial Fibrillation: The REHEARSE-AF study randomised ambulatory patients ≥65 years of age with stroke risk factors to twice-weekly single-lead iECG for 1 year and demonstrated the acceptance of this screening method and a possible benefit for stroke risk.[19] The partly randomised mHealth Screening to Prevent Strokes (mSToPS) study suggested that active monitoring with a rhythm patch in high-risk individuals with AF without symptoms may reduce adverse outcomes over 3 years follow-up.[24] Outcome data of the currently published systematic screening trials Systematic ECG Screening for Atrial Fibrillation Among 75 Year Old Subjects in the Region of Stockholm and Halland, Sweden (STROKESTOP)[20] and Danish Atrial Fibrillation Detected by Continuous ECG Monitoring (LOOP) show controversial results.[25] Ongoing studies examine stroke rates, major bleeding, and mortality with different AF screening approaches. These data will help to establish evidence of the relative risks and benefits of AF screening and concomitant anticoagulation.[20 22 25] Thus, healthcare providers and decision-makers like those in the current study who cited the need for more evidence, will soon have much more data at hand to assess the effectiveness of AF screening.

Opportunistic single time point screening (online supplemental file 1: scenario 1) is one of the guideline-recommended ways of AF screening[1] and in our study was considered as the most feasible approach. Primary care was suggested as the most efficient setting for implementation. The most frequently mentioned advantage for scenario 1 was ease of implementation and lower costs for the healthcare system compared with the other screening approaches. This was partly due to the use of single-lead ECG devices as outlined in scenario 1, which have been previously identified as presenting a good alternative to 12-lead ECGs for initial screening in a primary care setting.[26] A recent study showed controversial results regarding the effectiveness of single time point measurement.[27 28] This is possibly because effectiveness may be determined by what happens in the comparator of usual care. The usual care arm was particularly effective in the Netherlands general practice setting inside the large Detecting and Diagnosing Atrial Fibrillation (D2AF) study[28] and similarly in the VITALS AF study in the USA.[22] Where usual care is already good at detecting AF, an increase in opportunistic screening would be neither effective nor cost-effective. The situation of such high prevalence and incidental detection is unlikely to be widespread in Europe, therefore more randomised clinical trials to examine this approach are needed.

Besides primary care, other locations such as pharmacies, dentists or podiatrists were suggested by the participants to have the potential for AF screening. A current pharmacy-based AF screening study including 7100 patients showed a relatively high detection rate of 3.6% for unknown AF when using a single time point measurement with a hand-held ECG.[29] Another study determined that screening with iECG in pharmacies with an automated algorithm were feasible and cost-effective.[30] A recent study with a follow-up of 17 years report a significant association of periodontal disease and AF that possibly explain the cardioembolic stroke risk with periodontal disease.[31] However, dentist and podiatrists are not a focus for AF screening by current research and could be considered for further investigations of appropriate screening settings. Other possibilities not covered include patient self-screening in GP waiting rooms.[32]

The interview participants stated that the most effective approach to detect new AF cases would possibly be prolonged screening (online supplemental file 1: scenario 2 or 3). Continuous 2-week patches as in (mSToPS study),[24] or intermittent ECG snapshot screening over a few weeks as used in the STROKESTOP[20] and Screening for Atrial Fibrillation with ECG to Reduce stroke (SAFER) studies could be applied in primary care. However, these approaches were considered too expensive to implement with existing resources in healthcare settings across European regions. This indicates a need to include cheaper reusable devices. For example, new affordable devices such as an electrocardiographic (ECG) patch that was used in a recent randomised clinical trial that screened high-risk individuals aged ≥75 years for 2 weeks continuously showed a relatively high detection rate of 5.3% compared with standard of care (0.5%) with an accuracy of 87% for AF diagnosis. The device was also well tolerated by the patients.[33]

Our results suggest that patient-led screening already exists in all participating countries. This type of approach has the potential to increase AF detection rate if screening is driven by the use of wearables for prolonged self-measurement in the general population, as demonstrated by the Apple Heart and Huawei studies.[34–37] However, interviewees suggested that this approach also presented challenges for data management and follow-up of false positive cases in younger age individuals who do not fall into the targeted group for AF screening. In the Apple Heart Study, which included >400 000 participants, 52% were <40 years of age. Among those individuals, only 341 (0.16%) were notified of an irregular finding, and of these, only 9 (0.004%) had AF. Therefore, 97% of participants <40 years of age received false positive alerts that could possibly lead to adverse effects such as anxiety, medical counselling and potential further workup. Patient-led screening was also considered to create potential pressure for individuals with a lower socioeconomic status to invest and buy such wearables. The experts were concerned that

this approach could contribute to increasing a general health inequality problem. This is consistent with other research where older age, low health literacy and low socioeconomic status are factors associated with lower uptake of digital health solutions.[38 39] Higher educated individuals use this kind of technology more often or are more likely to benefit from the usage of such technologies,[39] and the spread of digital devices could possibly result in even more inequalities in health.[40 41] A general concern of using wearables for AF screening was also highlighted by a survey conducted among HCP, in which ~70% felt we were not yet ready for this approach.[42] Thus, current approaches have to focus on and develop mitigation strategies to overcome health inequalities due to the use of wearables to detect AF.

General population-based promotion programmes seem to exist more commonly in Nordic and northern/central European countries with a focus on lifestyle modifications and cardiovascular disease. Unequal health promotion programmes guided though different national healthcare policies in the European countries to address cardiovascular disease have been reported in other studies.[43] Large social disparities and inadequate government health expenditure are major barriers to clinical prevention of cardiovascular disease in Eastern Europe.[44]

Our study highlighted that the development of standardised implementation structures for AF screening across Europe is rather unlikely due to different payment mechanisms and regional or national healthcare regulations within each country. Action plans such as the World Heart Federation's Roadmap for Nonvalvular Atrial Fibrillation[45] or publicly funded screening implementation research such as the EU-funded AFFECT-EU consortium (affect-eu.eu) have the potential to engage decision-makers and could serve as a model for countries to develop AF policies and update their national disease action plans.[46]

The interviewees suggested that costs for telehealth provision were not covered by current reimbursement systems and could create potential conflicts between primary care and the new service providers of the second or third healthcare market. However, telehealth presents a possible solution in particular for low-income and middle-income areas with a large territory and an acute deficit of HCP to increase the integration of low-cost medical services.[47] In addition, the impact of the COVID-19 public health emergency has created an unprecedented opportunity for regulatory changes with regard to telehealth provision.[48] These changes could help to address the current telehealth provision for targeted screening solutions in Europe.[49] Some experts suspected that if AF screening is implemented, primary care physicians would need to be prepared to take the responsibility for diagnosis and treatment. Nevertheless, studies showed a lack of accurate detection of AF on an ECG by primary care professionals. Therefore, training and education would need to be provided, possibly supported by telehealth applications.[50]

### Methodological considerations

AF is an established risk marker for clinical outcomes such stroke and heart failure. It is increasingly recognised that AF frequently is undetected until complications occur, which has given rise to an interest in detecting AF earlier in a preventive healthcare setting. Recent studies vindicate the recommendation for opportunistic screening as set out in the ESC guidelines.[51 52] However, the evidence to support more systematic wide-spread screening remains extremely limited and larger randomised trials of the different approaches versus no screening and individual-patient data meta-analysis of these studies[53] to prevent stroke or other adverse outcomes are needed. However, general technical advances such as digital wearables are driving forces for screening and are increasingly applied whether recommended or not. In this qualitative feasibility study, we investigated positions towards the most promising screening approaches that are currently of interest, and in some settings recommended by a variety of professional societies and organisations. Our study addresses the question of whether AF screening can work in practice and how. As, such, it focused on process considerations rather than outcomes evidence.

HCP experts outside the consortium were invited to avoid selection bias. However, as experts with strong opinions on screening may have been more likely to agree to participate, some selection bias is possible. In addition, we invited regulators of each respective country specifically because they have experience evaluating screening implementation for other conditions in their regional context, and we assume that these stakeholders have an objective perspective to AF screening approaches. Diverse aspects and approaches were reported, suggesting that severe selection bias is unlikely. In the majority of cases, the interviews were conducted in participants' native language and translated into English, therefore translation bias is possible. Nevertheless, the interviewees were able to express their thoughts very clearly within this study design. The sampling strategy aimed to maximise experience of AF screening and regulatory knowledge of implementing national screening programmes rather than be representative of HCP and health regulators across Europe.

Qualitative analysis is inherently subjective as it is influenced by the assumptions, beliefs and biases of the researcher.[54] In this study, the majority of researchers had a special interest in AF screening, with the exception of the main data analyst (CLH), which may have reduced biases due to preconceived ideas about results. Potential biases were explored during data workshops and group discussions with all authors. The study identified a range of themes and possible opportunities for screening implementation, but large-scale work is warranted to see whether the identified feasible approaches of the suggested screenings are robust, and whether they explain the patterns of opportunities and obstacles for screening implementation across Europe.

A major strength of this study includes a heterogeneous sample of both HCP and healthcare regulators with a wide range of backgrounds.

## CONCLUSION

Qualitative data based on stakeholder knowledge across Europe indicate that there is an overall awareness of AF as a relevant disease, and an acknowledgement of the need for screening. In contrast to other healthcare promotion efforts, AF screening programmes have not been implemented in any of the countries or regions. Opportunistic screening is deemed to be the scenario most likely be realised in the near future, probably at GP offices, but other settings can be considered. Obstacles, in particular the lack of evidence for effectiveness of screening from randomised trials, appear to be surmountable. Information from our interviews can inform the design and implementation of AF screening programmes. Thus, the obvious gap between guideline recommendations and AF screening reality may be closed.

**Author affiliations**
[1]Department of Cardiology, University Medical Center Hamburg-Eppendorf, University Heart & Vascular Center Hamburg, Hamburg, Germany
[2]German Center for Cardiovascular Research (DZHK) partner site Hamburg/Kiel/Lübeck, Hamburg, Germany
[3]School of Health and Social Care, Edinburgh Napier University, Edinburgh, UK
[4]Heart Center Hasselt, Jessa Hospital, Hasselt, Belgium
[5]Department of Cardiology, Antwerp University Hospital, Antwerp, Belgium
[6]Faculty of Medicine and Life Sciences, Hasselt University, Hasselt, Belgium
[7]Research Group Cardiovascular Diseases, University of Antwerp, Antwerp, Belgium
[8]Cardiology Division, Department of Biomedical, Metabolic and Neural Sciences, University of Modena and Reggio Emilia, Policlinico di Modena, Modena, Italy
[9]Department of Cardiology, Rigshospitalet, Copenhagen University Hospital, Copenhagen, Denmark
[10]Heart Research Institute, The University of Sydney, Sydney, New South Wales, Australia
[11]University of Sydney, Charles Perkins Centre, Sydney, New South Wales, Australia
[12]Deptartment of Cardiology, Concord Hospital, Concord, Sydney, Australia
[13]Neurovascular Research Laboratory, Vall d'Hebron Institute of Research (VHIR), Autonomous University of Barcelona, Barcelona, Spain
[14]Deptartment for Intensive Arrhythmia Care, Cardiology Clinic, Clinical Center of Serbia, Belgrade, Serbia
[15]School of Medicine, University of Belgrade, Beograd, Serbia
[16]Pfizer Pharma GmbH, Berlin, Germany
[17]Sydney Nursing School, University of Sydney, Sydney, New South Wales, Australia

**Twitter** Coral L Hanson @HansonCoral and Lis Neubeck @lisneubeck

**Acknowledgements** We thank the participants and dedicated study staff of the AFFECT-EU studies for their generous contribution of time and efforts.

**Collaborators** AFFECT-EU investigators (all collaborators are named in the title).

**Contributors** CLH and DE have originally designed the study both are guarantors of the research project. LD, GB, EP, TSP, DE and CLH have acquired the data. CLH, DE, LN and RS have analysed the data. CLH, DE, LN, RS, HH and LD have interpreted the data. CLH and DE have drafted the article and BF, HW and the other authors have critically revised it. All authors undertake to give final approval of the version to be published and agree to be accountable for all aspects of the work.

**Funding** RS has received funding from the European Research Council under the European Union's Horizon 2020 research and innovation program (grant agreement no. 648131); the German Center for Cardiovascular Research (DZHK) (81Z1710103); the European Union's Horizon 2020 research and innovation programme (grant agreement no. 847770, AFFECT-EU) and ERACoSysMed3 (031L0239).

**Competing interests** RS has received speaker and advisory board honoraria by BMS/Pfizer outside this work. BF reports research grants to institution for investigator initiated studies from BMS/Pfizer alliance, and speaker fees and non-financial support from BMS/Pfizer, Daiichi Sankyo and OMRON. GB reported speaker's fees of small amount from Bayer, Boehringer, Boston, Biotronik and Medtronic. HH did receive personal fees from Biotronik and BMS/Pfizer. He received unconditional research grants through the University of Antwerp and/or the University of Hasselt from Bayer, Boehringer-Ingelheim, Bracco Imaging Europe, Abbott, Medtronic, Biotronik, Daiichi Sankyo, BMS/Pfizer and Boston Scientific, all outside the scope of this work. SZD is a part-time employee of Vital Beats without relation to the current work. TSP: consultancy (no fee) and small speaker fee from Bayer and BMS/Pfizer outside this work.

**Patient and public involvement** Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

**Patient consent for publication** Consent obtained directly from patient(s).

**Ethics approval** Hamburg Medical Association Ethics Committee reviewed this study and deemed it service evaluation. The investigation conforms to the principles outlined in the Declaration of Helsinki.

**Provenance and peer review** Not commissioned; externally peer reviewed.

**Data availability statement** Data are available on reasonable request. The data underlying this article were provided by the AFFECT-EU Consortium by permission. Data will be shared on request to the corresponding author with permission of the AFFECT-EU Consortium is also expected but not yet confirmed.



**ORCID iDs**
Daniel Engler http://orcid.org/0000-0002-9519-6258
Coral L Hanson http://orcid.org/0000-0003-1602-1968
Giuseppe Boriani http://orcid.org/0000-0002-9820-4815
Søren Zöga Diederichsen http://orcid.org/0000-0002-9687-0857
Ben Freedman http://orcid.org/0000-0002-3809-2911
Tatjana S Potpara http://orcid.org/0000-0001-6285-6902
Renate B Schnabel http://orcid.org/0000-0001-7170-9509

## REFERENCES

1 Hindricks G, Potpara T, Dagres N, *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.
2 Benjamin EJ, Muntner P, Alonso A, *et al*. Heart disease and stroke Statistics-2019 update: a report from the American heart association. *Circulation* 2019;139:e56–28.
3 Schnabel RB, Yin X, Gona P, *et al*. 50 year trends in atrial fibrillation prevalence, incidence, risk factors, and mortality in the Framingham heart study: a cohort study. *Lancet* 2015;386:154–62.
4 Miyasaka Y, Barnes ME, Gersh BJ, *et al*. Secular trends in incidence of atrial fibrillation in Olmsted County, Minnesota, 1980 to 2000, and implications on the projections for future prevalence. *Circulation* 2006;114:119–25.
5 Stefansdottir H, Aspelund T, Gudnason V, *et al*. Trends in the incidence and prevalence of atrial fibrillation in Iceland and future projections. *Europace* 2011;13:1110–7.

6 Wolf PA, Abbott RD, Kannel WB. Atrial fibrillation as an independent risk factor for stroke: the Framingham study. *Stroke* 1991;22:983–8.
7 Friberg L, Rosenqvist M, Lindgren A, *et al*. High prevalence of atrial fibrillation among patients with ischemic stroke. *Stroke* 2014;45:2599–605.
8 Lubitz SA, Yin X, McManus DD, *et al*. Stroke as the initial manifestation of atrial fibrillation: the Framingham heart study. *Stroke* 2017;48:490–2.
9 Hart RG, Pearce LA, Aguilar MI. Meta-analysis: antithrombotic therapy to prevent stroke in patients who have nonvalvular atrial fibrillation. *Ann Intern Med* 2007;146:857–67.
10 Freedman B, Camm J, Calkins H, *et al*. Screening for atrial fibrillation: a report of the AF-SCREEN international collaboration. *Circulation* 2017;135:1851–67.
11 , Davidson KW, Barry MJ, *et al*, US Preventive Services Task Force. Screening for atrial fibrillation: US preventive services Task force recommendation statement. *JAMA* 2022;327:360–7.
12 Zungsontiporn N, Link MS. Newer technologies for detection of atrial fibrillation. *BMJ* 2018;363:k3946.
13 Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *Int J Qual Health Care* 2007;19:349–57.
14 Patton MQ. *Qualitative research & evaluation methods : integrating theory and practice*. 268. 4th edn. Sage publications, 2015.
15 Engler D, Heidbuchel H, Schnabel RB. Digital, risk-based screening for atrial fibrillation in the European community—the AFFECT-EU project funded by the European Union. *Eur Heart J* 2021;42:2625–7.
16 Braun V, Clarke V. Reflecting on reflexive thematic analysis. *Qualitative Research in Sport, Exercise and Health* 2019;11:589–97.
17 Ritchie J, Spencer L. Qualitative data analysis for applied policy research. *The qualitative researcher's companion* 2002;2002:305–29.
18 Jones NR, Taylor CJ, Hobbs FDR, *et al*. Screening for atrial fibrillation: a call for evidence. *Eur Heart J* 2020;41:1075–85.
19 Halcox JPJ, Wareham K, Cardew A, *et al*. Assessment of remote heart rhythm sampling using the AliveCor heart monitor to screen for atrial fibrillation. *Circulation* 2017;136:1784–94.
20 Svennberg E, Engdahl J, Al-Khalili F, *et al*. Mass screening for untreated atrial fibrillation: the STROKESTOP study. *Circulation* 2015;131:2176–84.
21 Svendsen JH, Diederichsen SZ, Højberg S, *et al*. Implantable loop recorder detection of atrial fibrillation to prevent stroke (the loop study): a randomised controlled trial. *Lancet* 2021;398:1507–16.
22 Ashburner JM, Atlas SJ, McManus DD, *et al*. Design and rationale of a pragmatic trial integrating routine screening for atrial fibrillation at primary care visits: the VITAL-AF trial. *Am Heart J* 2019;215:147–56.
23 Hobbs F, Fitzmaurice D, Mant J, *et al*. A randomised controlled trial and cost-effectiveness study of systematic screening (targeted and total population screening) versus routine practice for the detection of atrial fibrillation in people aged 65 and over. The safe study. *Health Technol Assess* 2005;9.
24 Steinbubl SR, Waalen J, Sanyal A. 3-years clinical outcomes in a Nationalwide pragmatic clinical trial of atrial fibrillation Screening-mHealth screening to prevent Stokes (mSToPS). AHA scientific sessions 2020.
25 Diederichsen SZ, Haugan KJ, Kronborg C, *et al*. Comprehensive evaluation of rhythm monitoring strategies in screening for atrial fibrillation. *Circulation* 2020;141:1510–22.
26 Ramkumar S, Nerlekar N, D'Souza D, *et al*. Atrial fibrillation detection using single lead portable electrocardiographic monitoring: a systematic review and meta-analysis. *BMJ Open* 2018;8:e024178.
27 Zwart LA, Jansen RW, Ruiter JH, *et al*. Opportunistic screening for atrial fibrillation with a single lead device in geriatric patients. *J Geriatr Cardiol* 2020;17:149–54.
28 Uittenbogaart SB, Verbiest-van Gurp N, Lucassen WAM, *et al*. Opportunistic screening versus usual care for detection of atrial fibrillation in primary care: cluster randomised controlled trial. *BMJ* 2020;8:m3208.
29 Zink MD, Mischke KG, Keszei AP, *et al*. Screen-detected atrial fibrillation predicts mortality in elderly subjects. *Europace* 2021;23:29–38.
30 Lowres N, Neubeck L, Salkeld G, *et al*. Feasibility and cost-effectiveness of stroke prevention through community screening for atrial fibrillation using iPhone ECG in pharmacies. The SEARCH-AF study. *Thromb Haemost* 2014;111:1167–76.
31 Sen S, Redd K, Trivedi T, *et al*. Periodontal disease, atrial fibrillation and stroke. *Am Heart J* 2021;235:36–43.
32 Giskes K, Lowres N, Li J, *et al*. Atrial fibrillation self screening, management and guideline recommended therapy (AF self smart): a protocol for atrial fibrillation self-screening in general practice. *Int J Cardiol Heart Vasc* 2021;32:100683.
33 Gladstone DJ, Wachter R, Schmalstieg-Bahr K, *et al*. Screening for atrial fibrillation in the older population: a randomized clinical trial. *JAMA Cardiol* 2021;6:558–67.
34 Perez MV, Mahaffey KW, Hedlin H. Large-Scale assessment of a Smartwatch to identify atrial fibrillation 2019;381:1909–17.
35 Guo Y, Wang H, Zhang H, *et al*. Mobile Photoplethysmographic technology to detect atrial fibrillation. *J Am Coll Cardiol* 2019;74:2365–75.
36 Denas G, Battaggia A, Fusello M, *et al*. General population screening for atrial fibrillation with an automated rhythm-detection blood pressure device. *Int J Cardiol* 2021;322:265–70.
37 Khurshid S, Healey JS, McIntyre WF. Population-Based screening for atrial fibrillation 2020;127:143–54.
38 National Institute for Health and Care Excellence. Evidence standards framework for digital health technologies, 2020. Available: https://www.nice.org.uk/Media/Default/About/whatwe-do/our-programmes/evidence-standards-framework/digital-evidence-standards-framework.pdf
39 Boriani G, Maisano A, Bonini N, *et al*. Digital literacy as a potential barrier to implementation of cardiology tele-visits after COVID-19 pandemic: the INFO-COVID survey. *J Geriatr Cardiol* 2021;18:739.
40 Arcaya MC, Figueroa JF. Emerging trends could exacerbate health inequities in the United States. *Health Aff* 2017;36:992–8.
41 Deaton A. *The great escape: health, wealth, and the origins of inequality*. Princeton University Press, 2013.
42 Boriani G, Schnabel RB, Healey JS, *et al*. Consumer-led screening for atrial fibrillation using consumer-facing wearables, devices and apps: a survey of health care professionals by AF-SCREEN international collaboration. *Eur J Intern Med* 2020;82:97–104.
43 Mackenbach JP, Karanikolos M, McKee M. The unequal health of Europeans: successes and failures of policies. *Lancet* 2013;381:1125–34.
44 Movsisyan NK, Vinciguerra M, Medina-Inojosa JR, *et al*. Cardiovascular diseases in central and eastern Europe: a call for more surveillance and evidence-based health promotion. *Ann Glob Health* 2020;86:21.
45 Murphy A, Banerjee A, Breithardt G, *et al*. The world heart Federation roadmap for nonvalvular atrial fibrillation. *Glob Heart* 2017;12:273–84.
46 Norrving B, Barrick J, Davalos A, *et al*. Action plan for stroke in Europe 2018-2030. *Eur Stroke J* 2018;3:309–36.
47 Hoffer-Hawlik MA, Moran AE, Burka D, *et al*. Leveraging telemedicine for chronic disease management in low- and middle-income countries during Covid-19. *Glob Heart* 2020;15:63.
48 Telehealth is here to stay. *Nat Med* 2021;27:1121–21.
49 Hoffman DA. Increasing access to care: telehealth during COVID-19. *J Law Biosci* 2020;7:lsaa043.
50 Mant J, Fitzmaurice DA, Hobbs FDR, *et al*. Accuracy of diagnosing atrial fibrillation on electrocardiogram by primary care practitioners and interpretative diagnostic software: analysis of data from screening for atrial fibrillation in the elderly (safe) trial. *BMJ* 2007;335:380.
51 Benjamin EJ, Go AS, Desvigne-Nickens P, *et al*. Research priorities in atrial fibrillation screening. *Circulation* 2021;143:372–88.
52 Sun W, Freedman B, Martinez C, *et al*. Atrial fibrillation detected by single Time-Point handheld electrocardiogram screening and the risk of ischemic stroke. *Thromb Haemost* 2022;122:286–94.
53 AF screen international collaboration. Available: https://www.afscreen.org/ [Accessed 11 Apr 2022].
54 Holmes AGD. Researcher Positionality-A consideration of its influence and place in qualitative Research-A new researcher guide. *Shanlax International Journal of Education* 2020;8:1–10.