ESC European Society of Cardiology

European Journal of Preventive Cardiology (2025) **00**, 1–12
https://doi.org/10.1093/eurjpc/zwaf558

FULL RESEARCH PAPER
Cardiac rehabilitation

Identifying rehabilitation needs as part of secondary prevention in individuals with atrial fibrillation—a Delphi consensus study

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Received 16 December 2024; revised 23 February 2025; accepted 22 August 2025; online publish-ahead-of-print 9 September 2025

Aims This study aimed to establish general consensus on a systematic needs assessment model to determine eligibility for cardiac rehabilitation (CR) as part of secondary prevention in individuals with atrial fibrillation (AF). Specific objectives included identifying relevant needs assessment criteria and establishing consensus on referral criteria.

Methods and results A Delphi study was conducted following the ACCORD guidelines (ACcurate COnsensus Reporting Document) with participation of an international, multi-disciplinary expert panel including physicians, nurses, and other healthcare professionals,

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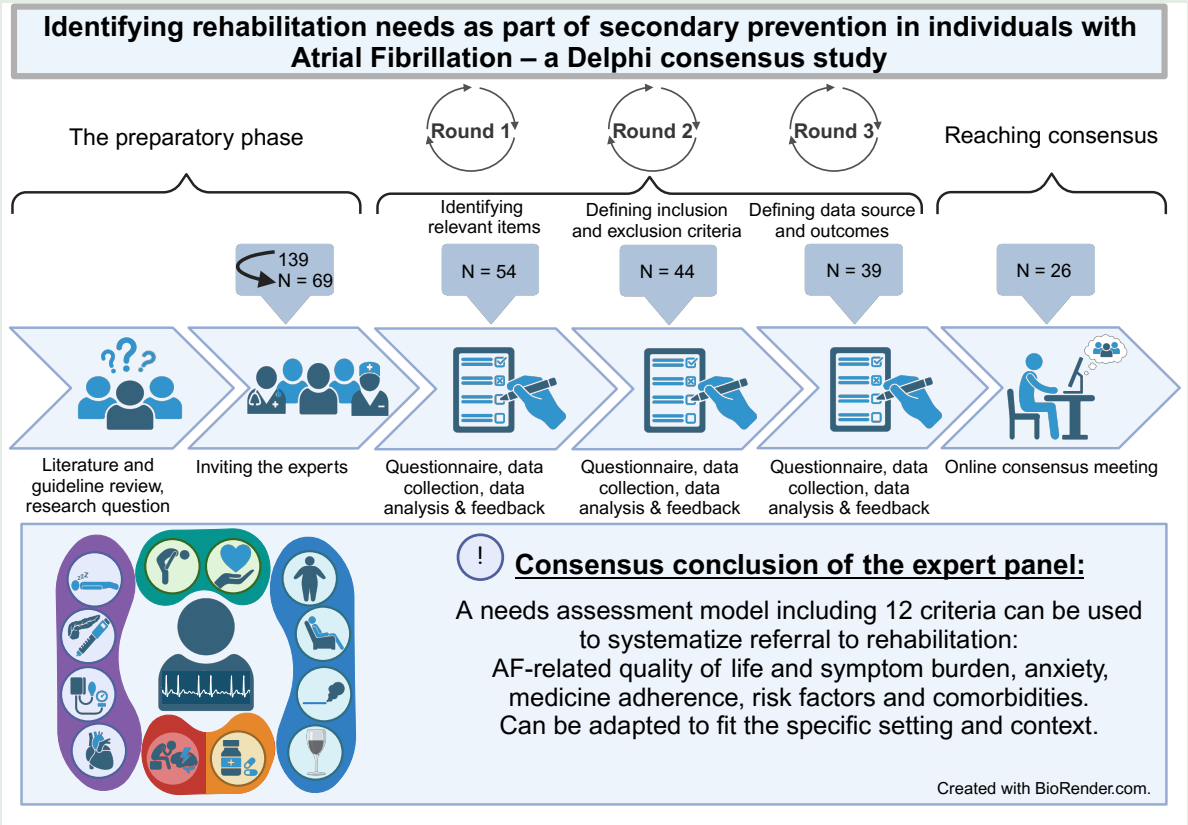
across primary and secondary care as well as academic research. The panel also included six people who had AF themselves. The Delphi process involved three iterative rounds of surveys and a video meeting to determine needs assessment criteria and facilitate consensus. Data collection included qualitative feedback and quantitative voting on proposed criteria. Sixty-nine experts participated. There was high agreement on the importance of the study, which identified 12 needs assessment criteria related to AF symptom burden, health-related quality of life, anxiety, medicine adherence, and various risk factors. Whilst there was agreement on the needs assessment model, experts noted that referral criteria should be flexible and tailored to local healthcare settings, emphasizing that each individual's situation is unique.

Conclusion This Delphi study established a needs assessment model that can be adapted to local contexts for individuals with AF. More research is needed to refine referral criteria and ensure effective implementation of individually tailored CR strategies.

Lay summary This study aimed to create a model that helps healthcare providers assess the needs of individuals with atrial fibrillation to determine their eligibility for cardiac rehabilitation as part of secondary prevention. The key findings were:

- An expert panel identified 12 important criteria for assessing the needs of individuals with atrial fibrillation, including factors such as symptom burden, quality of life, anxiety, medicine adherence, and various risk factors.
- Whilst there was high agreement on the needs assessment model, experts noted that referral criteria should be flexible and tailored to local healthcare settings, emphasizing that each individual's situation is unique.

Graphical Abstract



Keywords Atrial fibrillation • Cardiac rehabilitation • Secondary prevention • Needs Assessment • Delphi technique • Consensus

Introduction

The management of atrial fibrillation (AF) has traditionally focused on stroke prevention and symptom relieve through rate and/or rhythm control, primarily using medical therapy and, increasingly, catheter ablation.[1] Since 2010, guidelines for the management of AF began to acknowledge the importance of treating underlying cardiovascular conditions like hypertension[1,2] but mainly through drug therapy. Subsequently, studies showed that non-pharmacological interventions, such as lifestyle modification and risk factor management reduce recurrences of symptomatic AF,[3–7] when combined with rate and/or rhythm control therapy. As AF management developed, the concept of

integrated care evolved and comprises medical, interventional, and non-pharmacological treatment strategies.[8,9] This approach includes a patient-centred focus, involvement of multidisciplinary teams, and use of technology.[8] Integrated care is an important element of the novel AF-CARE approach highlighted in the 2024 European Society of Cardiology (ESC) guidelines, which puts managing comorbidities and risk factors in the first place of AF management.[10]

Meanwhile, cardiac rehabilitation (CR) as part of secondary prevention has become central to cardiovascular care,[11] with exercise training and patient education as core components.[12,13] Whilst current AF guidelines do not explicitly mention CR, several elements, such as lifestyle changes and patient education, align with the AF-CARE approach[10] and the concept of 'cardiovascular health rehabilitation'.[14] Indeed, research suggests that integrated care and CR interventions including patient education, physical exercise, and risk factor management might improve health-related quality of life (HRQoL),[15–19] reduce arrhythmia recurrences and symptom burden,[20–23] lower hospital readmissions,[24–27] and reduce all-cause mortality[28] in individuals with AF.

The primary care setting (mainly municipality-based or by providers outside the hospital sector) is expected to play a crucial role in delivering CR for individuals with AF in many healthcare systems.[7,29] However, only a limited number of individuals with AF are currently referred to CR in primary or secondary care (hospital-based).[30–32] Notably, current AF guidelines do not provide systematic criteria to determine when individuals with AF should undergo individual health needs assessment[33] and be referred to CR.[8,10,34,35] To define these criteria, collaboration to establish consensus among healthcare professionals is essential. This would enable more informed decision-making, prioritizing limited healthcare resources, and standardization of AF care across different healthcare sectors.[36]

Therefore, the aim of this study was to establish general consensus on a systematic needs assessment model to determine eligibility for CR as part of secondary prevention in individuals with AF. The study focused on two specific objectives: (i) to identify relevant criteria for needs assessment and (ii) to establish consensus on referral for these individuals.

Methods

This Delphi study is reported in accordance to the ACCORD (ACcurate COnsensus Reporting Document) guideline[37] developed under the EQUATOR Network best practices for guideline development (checklist in Supplementary material online, *Table S1*).

Design

The study was conducted using the Delphi technique, a well-established method for gathering new knowledge and obtaining consensus through the collective expertise of a group of experts.[38] It is suitable for complex, uncertain issues where no knowledge exists, or when traditional decision-making processes may be insufficient to reach consensus on a particular topic.[38] The process included a preparatory phase, the Delphi rounds, and a reaching consensus phase (*Graphical abstract*).

Steering committee

A steering committee consisting of C.M.E., A. Brandes, S.S.R., and A.-D.Z. led the study. A. Brandes is a cardiologist and AF specialist. S.S.R. is an AF specialist nurse. A.-D.Z. is a cardiologist and CR prevention specialist. C.M.E. has significant experience in survey construction and data collection and has previously conducted CR research for individuals with AF. A. Brandes, S.S.R. and A.-D.Z. contributed with their professional and clinical knowledge to the development of the Delphi rounds, and to the initial formation of the expert list. C.M.E. steered the process as a project manager and conducted the surveys and data collection processes.

Selection of panellists

As general panel sizes around 40 experts are often used as a target panel sample size,[37] we aimed at inviting ~100 experts. This target panel size allowed us to have a diverse and acceptable number of responses and accounted for withdrawals or partial survey completion. The inclusion criteria specified that the experts had to be healthcare professionals with substantial clinical experience or expert knowledge in AF, rehabilitation, or secondary prevention. This was defined as contributing to research in AF and publishing within this field, practicing in a relevant clinical setting related to AF, leadership of multidisciplinary teams in a relevant clinical setting, or other kinds of active involvement in AF care and management. Additionally, the panel included individuals with AF, to ensure that patient perspectives were represented. While we did not validate expertise through objective metrics such as the number of research publications in high-impact scientific journals, we aimed to capture a diverse range of practical, clinical, and experiential knowledge combined with research experience in the field, which reflects the real-world complexities of AF care. Using a purposive sampling approach with the steering committees' professional network and screening relevant literature (guidelines and papers), names of potential relevant international, multi-disciplinary experts from various healthcare sectors and disciplines were listed. These were initially invited to participate. Then, we used the snow-balling sampling technique and asked the invited experts to recommend up to three potential additional experts within this area. Suggestions were reviewed for suitability according to the inclusion criteria and invited, if eligible. This approach expanded the expert panel by leveraging professional networks, ensuring a diverse range of perspectives within the field. Experts were invited using an online survey providing information about the study and asking the potential experts to confirm participation and share sociodemographic information. Invitations were sent between 20 September 2023 and 6 October 2023, with reminders sent 10 and 5 days before closing the invitation phase. New eligible experts received an invitation as soon as they were suggested by other experts.

The preparatory phase

First, we performed a rapid review of the literature using PubMed and of the AF management guidelines to investigate if needs assessment criteria to CR had been previously described, but found none. Second, after browsing the literature, the steering committee generated a list of items potentially relevant as needs assessment criteria for round one. These items were categorized as risk factors (lifestyle factors and comorbidities) for AF, psychosocial factors, self-management abilities, AF-related symptom burden, and quality of life. Invitations to the experts were sent during the preparatory phase.

The Delphi rounds

We used online surveys through the platform SurveyXact to collect data in the Delphi rounds. Experts who accepted the invitation received the first round survey via e-mail. The steering committee also participated and voted in the rounds, except for the project manager.

Three online surveys were conducted over the course of three iterative rounds. After each round, both quantitative (percentage agreement on each item) and qualitative (text box comments) feedback were analysed to inform the next round. Thus, each subsequent survey (second and third) was developed based on previous results, reflecting the iterative nature of the Delphi process. Especially, the open-ended responses were reviewed to identify suggestions for new items or modifications to existing ones or response options. The steering committee systematically synthesized this feedback and implemented necessary refinements, such as adding response options suggested by experts. The overall purpose was to identify relevant

needs assessment criteria. The specific purpose of the first round was to determine the relevance of potential items for inclusion in the model. Relevance was evaluated on a 5-point Likert-scale from 'Strongly agree' to 'Strongly disagree'. The second round focused on determining whether the items should be an inclusion or exclusion criterion in the model. The third round focused on defining the data source and evaluated whether the items could act as potential outcomes of CR. Data were collected individually during each round.

Each survey was constructed and designed by the project manager and piloted by the rest of the steering committee to ensure that information, feedback, items, and response options were accurate and logical. All items were pre-defined as 'required' in the survey, except for text boxes, ensuring no missing data from the experts. After each round, feedback to the experts was provided anonymously in the following round with qualitative descriptions before each item and quantitative presentations (number and percentages) of the results from the previous round (example in Supplementary material online, *Table S2*).

Furthermore, all items in each round included an open text field for the experts to comment on the vote or the item. Round one also offered the opportunity to propose new items. New proposed items were added to the second round and experts were asked to answer both round one and two questions for these. In addition, the three rounds also included four initial questions asking the experts to vote on the study's importance, which entities should bear responsibility for referring individuals with AF, the timing of referral, and how many criteria should be present for a referral to be considered.

The first Delphi round took place from 16 October 2023 to 6 November 2023, followed by the second round from 27 November 2023 to 18 December 2023, and the third round from 8 January 2024 to 29 January 2024. Thus, each round lasted 3 weeks, and reminders were sent 10 and 5 days before the round was closed. The interim 3-week period allowed for data analysis, survey construction, and piloting of the subsequent round. Potential non-responses in each round were recorded. We did not establish predefined actions to address non-response because our approach was to observe the response patterns as they developed and to decide on appropriate actions based on the specific circumstances. After the second round, we contacted non-responders to ask whether they were still interested in participating in the study. After the third round, the steering committee reviewed all results and prepared material for the online consensus meeting.

Assessing consensus

The steering committee pre-defined three levels of consensus:

- High consensus defined as ≥75% agreement on the status of the item.
- Moderate consensus defined as 50–74% agreement on the status of the item.
- Low consensus defined as 25–49% agreement on the status of the item.

No consensus was defined as <25% agreement on the status of the item.

The ≥75% agreement was chosen based on the systematic review by Diamond *et al.*,[38] establishing this as commonly used to define high consensus and ensure robustness of the findings. We chose to supplement with the moderate consensus (50–74%) and low consensus (25–49%), as we were motivated by the goal of capturing clinically important parameters, diverse perspectives and refining items over successive rounds of voting, particularly if consensus would not initially be strong. Only items that were unanimously rated as non-relevant (<25%) were excluded from further consideration, allowing the panel to further deliberate on items with potential value despite lower levels of initial agreement.

The 'reaching consensus' phase

In April 2024, an online, face-to-face, consensus meeting facilitated by the steering committee was held to establish final consensus on the model and provide an opportunity for the experts to give final remarks, reflections, or perspectives on the study. One week before the meeting, a document containing the results of each round was shared with the participants to allow them to prepare for the meeting. At the meeting, a presentation focusing on the Delphi process and the results were shared. Then, the experts had the opportunity to put forward comments and questions. The results were then discussed in greater detail within smaller groups. At the end of the meeting, one expert from each group gave feedback from the discussions to the plenum to reach a final consensus discussion.

Anonymity

During the preparatory phase and the Delphi rounds, anonymity of the experts was maintained. The online consensus meeting was not anonymous as it included presentation and discussion of the results of each round in a group setting.

Data analysis

Simple descriptive analysis using numbers and percentage agreement was applied to display the results. For the first round evaluating relevance, Likert scale categories 'Strongly agree' and 'Agree' where pooled to determine the level of agreement for relevance. In round two and three, percentages are presented for each response option. Open-ended text box answers were aggregated and analysed to identify important items, response options or other comments that needed to be incorporated in the following round. Given the aim of establishing general expert consensus rather than hypothesis testing, inferential statistical analyses were not conducted.[38] However, we conducted additional descriptive sub-group analyses, investigating consensus on needs assessment criteria in three groups of professions, i.e. physicians, nurses, or 'others'. Specifically, 'relevance' from the first round and status of 'inclusion criteria' or 'important information' from the second round, were analysed.

Ethics

The experts were informed that their response to the surveys constituted voluntary and informed consent to participate in the study and data collection. The study is registered at the Regional Committees on Health Research Ethics for Southern Denmark (20222000-24) and the Region of Southern Denmark's record of data processing activities (22/28369).

Results

The initial invitation was sent to 90 experts. Through the snow-balling method it was sent to another 49 experts; thus, a total of 139 experts were invited. In total, 69 (50%) accepted the invitation. Following drop-out between rounds two and three, 45 experts (65%) continued to participate. *Figure 1* shows the participation flow throughout the study.

The expert panel ($n = 69$) had a mean age of 51 years and 59% were females. The majority of the experts were from the Nordic countries (70%). The experts worked in different settings, 35% in secondary care, 16% in primary care and 32% in academic research (*Table 1*).

The experts highly agreed on the importance of the study, with 93% rating it as important or very important (*Figure 2*, box A). There was high agreement that the hospital physician (80%), the specialized AF nurse at the hospital (87%), and the general practitioner (76%) carry the responsibility for referring individuals with AF to CR (*Figure 2*, box B). The experts highly agreed (96%) that the timing of referral should be individualized, but should be offered early after AF diagnosis and re-evaluated later (*Figure 2*, box C). There was no agreement on the number of needs assessment criteria required for an individual to be referred. Equal voting (38%) was provided for either 'A diagnosis of AF is sufficient' or 'The presence of one criterion is sufficient'. Combining the categories suggesting the presence of one or more

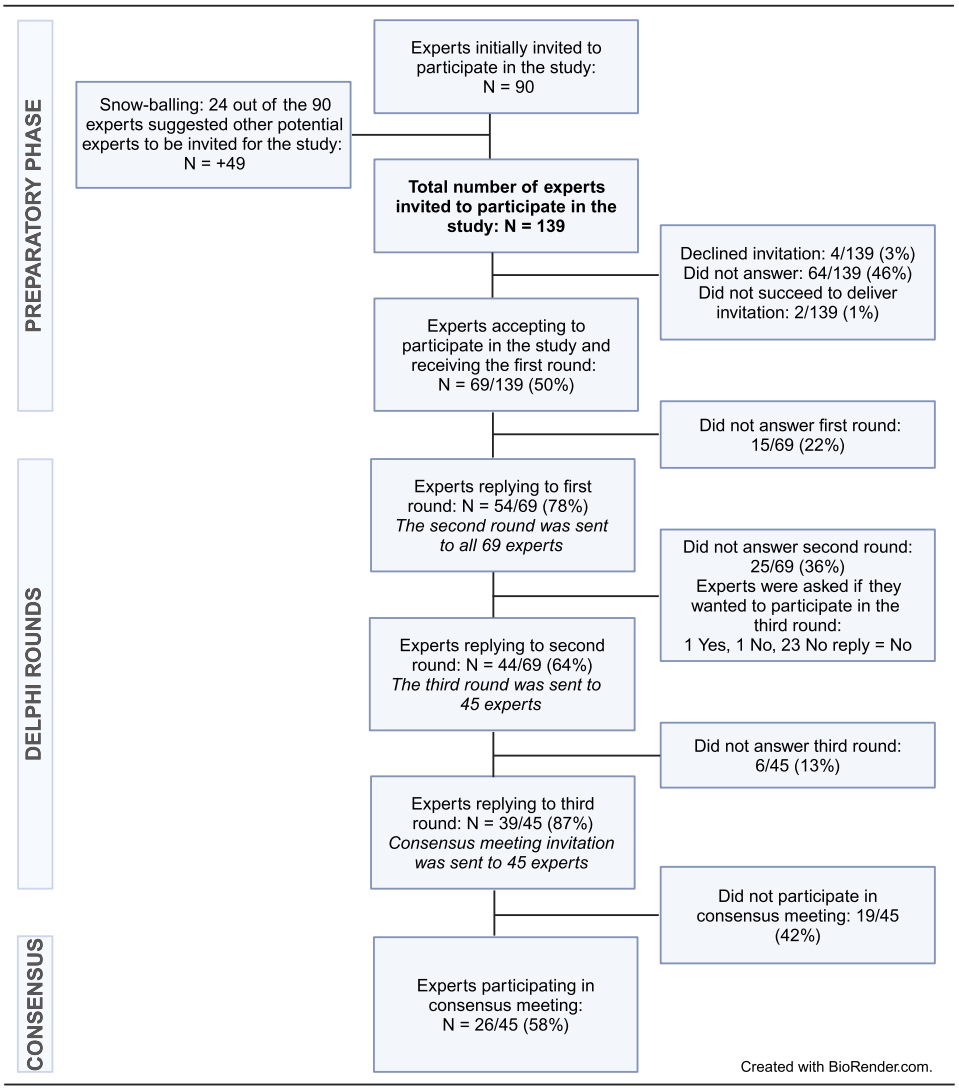


Figure 1 Flowchart of the participation in the Delphi process.

criteria, a majority (62%, moderate consensus level) favoured this approach compared to just having a diagnosis of AF (*Figure 2*, box D).

Following the first round, five additional items were suggested through open-ended feedback (see Supplementary material online, *Table S3*). Also, qualitative comments by the experts indicated that a binary classification of items (inclusion vs. exclusion) was too restrictive, as some items were deemed clinically relevant but not necessarily criteria. Based on this feedback, a refined response format was introduced in the second round, allowing experts to classify items as 'important information, but not inclusion criteria' or 'not relevant at all'. This change enabled a more nuanced assessment of the items and maintained the iterative nature of the Delphi process, improving the relevance and clarity of the final needs assessment model.

Inclusion criteria for the needs assessment

Twelve items were selected as inclusion criteria: high AF-related symptom burden, decreased AF-related quality of life, anxiety, medicine non-adherence, and risk factors divided in lifestyle (obesity, physical inactivity, smoking, and alcohol consumption/over-consumption), and co-morbidities (hypertension, diabetes/pre-diabetes, sleep apnoea, and other cardiac diseases) (*Table 2*). These were regarded as highly relevant by >75% of the experts and were voted as inclusion criteria at a moderate or high consensus level (>50%, however, medicine non-adherence received 49% of the votes, but higher voting for inclusion criteria than 'important information'). Ten of these items were also voted as potential outcomes (six with high agreement and four with moderate agreement). Supplementary material online, *Table S3* summarizes the results in percentages in all rounds.

The remaining items were regarded as important information for the overall assessment. These could be categorized into the sub-headings: psychosocial factors, self-management abilities, and risk factors divided in lifestyle and comorbidities (*Table 3*). Consensus on their relevance varied widely, ranging from high to low. Only one item (inflammatory bowel disease, IBD) was considered 'not relevant'; however, it received moderate agreement for being important information and was

Table 1 Characteristics of the experts who accepted to participate in the study

Variable	N = 69	
	Level	Results
Age (years)	Mean (SD) [range]	51 (10) [30–76]
	Median [IQR][a]	50 [44–57]
Gender	Female, *n* (%)	41 (59)
	Male, *n* (%)	28 (41)
Language	Danish speaking, *n* (%)	45 (65)
	English speaking, *n* (%)	24 (35)
Nationality	Nordic countries[b], *n* (%)	48 (70)
	European countries[c], *n* (%)	7 (10)
	UK and Ireland, *n* (%)	8 (11)
	USA, Canada, or Australia, *n* (%)	6 (9)
Occupation	Academic, *n* (%)	25 (36)
	Clinician, *n* (%)	23 (33)
	Academic and clinician, *n* (%)	14 (20)
	Other[d], *n* (%)	7 (10)
Employment	Primary care, *n* (%)	11 (16)
	Secondary care, *n* (%)	24 (35)
	Academic research, *n* (%)	22 (32)
	Other[e], *n* (%)	12 (18)
Education	Physicians, *n* (%)	27 (39)
	Nurses, *n* (%)	23 (33)
	Other[f], *n* (%)	19 (28)
Diagnosed with atrial fibrillation	Yes[g], *n* (%)	6 (9)

[a]IQR: inter quartile range (25–75%).
[b]Denmark and Sweden.
[c]Belgium, The Netherlands, Serbia, Germany.
[d]The seven people stated that they were four leaders, one general practitioner, one journalist, one patient advocate leader, one retired.
[e]The 12 people stated that they were 4 employed both in secondary care and as researchers, 2 worked at a tertiary care level, 1 in research and teaching, 1 in university and general practice, 1 worked in patient association, 1 worked in a private physiotherapy clinic, 1 did not work in the health sector, and 1 was retired.
[f]The 19 people were 5 physiotherapists (2 within research), 3 psychologists working with research, 1 clinical dietician, 1 social worker, 2 master of social science, 1 master of science in human nutrition, 1 public health, 1 in biomedical science, 1 teacher, 1 journalist, 1 consultant, and 1 had over 30 years of experience heading a non-profit organization.
[g]These were four patient representatives and two of the experts.

therefore kept (*Table 3*). IBD was one of the items added after round one and, therefore, results of rounds one and two were received during the second round.

Consensus meeting

Twenty-six of the 45 invited experts (58%) participated in the online consensus meeting. In general, the experts agreed with the results. However, they emphasized that the inclusion criteria (*Table 2*) should only be used in needs assessment for determining the necessity of referral, rather than as direct referral criteria. The experts noted that referral decisions would depend on the context, as healthcare systems, opportunities, and resources vary significantly between countries. Whilst they agreed that these factors should be considered, a deeper discussion was outside the scope of this study. Furthermore, the expert panel agreed that the number of needs assessment criteria needed to make a referral decision depended on the context, and thus no final consensus was reached on this matter (*Figure 2*, box D).

The discussion focused on three key perspectives. The first perspective was patient rights and universal healthcare offers for all, with a profound desire for treating everyone based on fundamental rights to receive healthcare and a value-based care approach. The second perspective was the severity and burden of disease, where the experts advocated to prioritize those with the greatest burden from AF and those with the most need for support. For example, some criteria could be weighted more heavily than others. The third perspective was the capacity to benefit from the interventions. The experts expressed a preference to treat those who would benefit the most from the available interventions. It was mentioned that the potential benefit of treating an individual fulfilling only one criterion (for example, the presence of a risk factor) might be less compared to individuals fulfilling several criteria. In general, the experts acknowledged that limited healthcare resources would be an argument for prioritization based on a needs assessment of whom should be referred. There was a broad agreement that 'one size does not fit all', emphasizing the need for local adaptation of the needs assessment model.

The final agreement was that all 12 criteria should be evaluated in a systematic needs assessment. However, local adaptation would be necessary to account for variations in healthcare systems, resource availability, and population needs. For example, adaptation could involve setting different thresholds for each criterion based on local disease burden, healthcare capacity, or socioeconomic factors. Similarly, the prioritization of criteria might depend on the availability of CR services or region-specific barriers to access. The experts highlighted that local adaptation should be dynamic, allowing for updates on emerging evidence and clinical guidelines. Furthermore, shared decision-making should remain central to the process, ensuring that individual patient circumstances and preferences are considered. Whilst no consensus was reached on a generic referral model, the agreement represents a flexible, generic needs assessment model designed to accommodate different healthcare settings. *Figure 3* illustrates the inclusion criteria of the final, generic, consensus-based, needs assessment model. Supplementary material online, Figure F1 distinguishes needs assessment from referral to CR and shows the process of how the model could be applied.

Additional analysis divided by profession

The analysis showed that physicians, nurses, and 'others' chose differently regarding the 12 needs assessment criteria (see Supplementary material online, *Table S4*). Regarding 'relevance', the results of the physicians were highly comparable with those of the entire group. Among nurses, 'anxiety' was relevant only at a moderate consensus level (decreasing to 72%). However, 'stress' reached a higher relevance among nurses and 'others' compared with physicians. 'Decreased HRQoL' reached moderate consensus in relevance among nurses and 'others'. There were some differences in the votes regarding 'comorbidities' between the three groups; however, none of them influenced the needs assessment criteria. Nurses also voted 'health literacy' with lower relevance compared to physicians and 'others'. Related to being 'inclusion criteria or important information', the physicians choose 11 criteria for their final needs assessment model. These were the same as in the total model, excluding 'anxiety' from

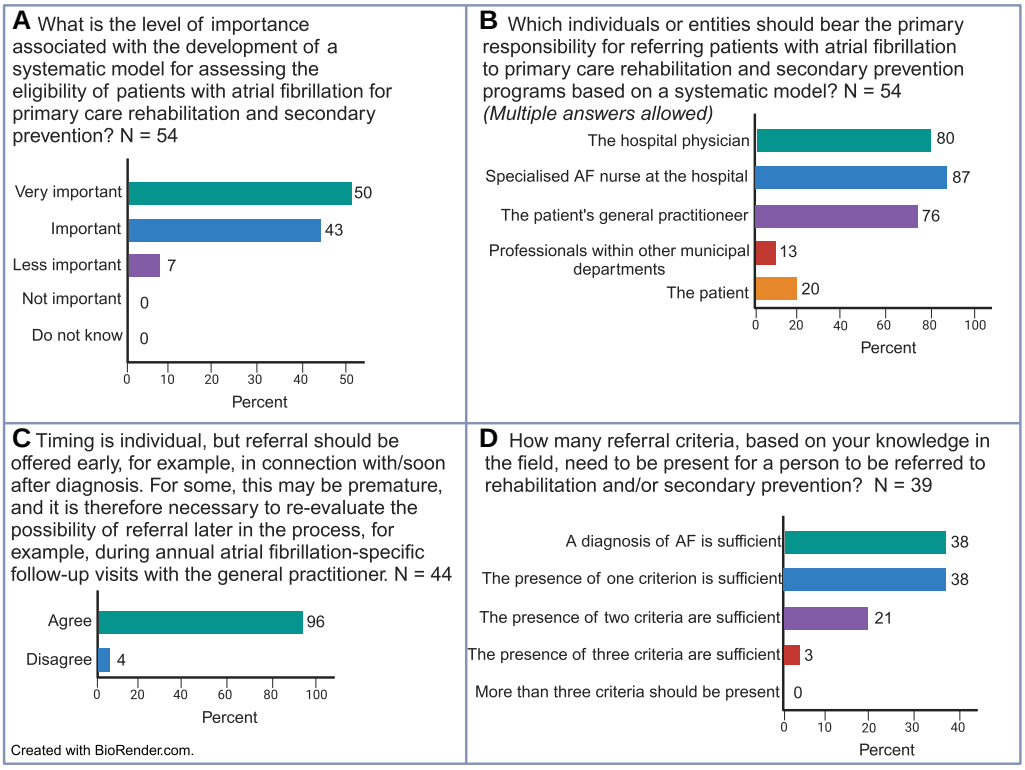


Figure 2 Results of the four initial questions regarding the study's importance, entities with responsibility for referral, the timing of referral and number of items needed for referral to be considered. Box A and B: results of round 1; therefore; *N* = 54. Box C: results of round 2; therefore, *N* = 44. Box D: results of round 3; therefore; *N* = 39.

the model. The nurses choose eight criteria, excluding 'decreased HRQoL' and 'medicine non-adherence' from their final model and with 50/50% votes for 'smoking' and 'cardiac comorbidity' being inclusion criteria or important information, i.e. doubts about the status of these items. Interestingly, self-assessed need for rehabilitation also reached 50/50% votes among nurses, with the same level of relevance as 'smoking', making it equally relevant for considering in the nurses' final model. The group of 'others' choose nine criteria in their final model. These were the same as the total model, excluding 'alcohol consumption/over-consumption', 'sleep apnoea' and 'decreased HRQoL'.

Discussion

In this study, an international consensus-based needs assessment model was developed. The model can be used as a starting point of systematizing referrals to CR in AF and potentially inform future AF guidelines. The findings highlight the urgent need to raise awareness about referrals to CR, to enhance equality in AF care. The consensus-based needs assessment model includes 12 criteria: AF-related symptom burden, quality of life, anxiety, medicine non-adherence, and risk factors divided in lifestyle (obesity, physical inactivity, smoking, and alcohol consumption/over-consumption), and comorbidities (hypertension, diabetes/pre-diabetes, sleep apnoea, and other cardiac diseases). These criteria are essential for systematic needs assessment and could be used to inform and potentially determine the need for referral, alongside the items identified as 'important information' as these could lead to important modifications in the individual situation. Additional analyses divided into three sub-groups of profession showed that not all criteria were chosen in all three sub-groups. The final model of physicians was closest to the final model of the entire group, excluding only 'anxiety'. Nurses and 'others' excluded a few more criteria, and nurses considered 'self-assessed need of CR' to be equally important compared to 'smoking'. Hence, this could be a criterion as well in the nurses' final model. It is an important finding that not all professions evaluate needs in the same way, when considering referral to CR in AF.

No consensus was reached on using the 12 criteria as a strict referral model or specifying the number of criteria required for referral. Instead, the flexibility of the model allows for adaptation to different contexts and country-specific healthcare settings. Local adaptations may involve adjusting thresholds for each criterion based on regional disease burden, healthcare capacity, or socioeconomic factors, as well as prioritizing criteria according to service availability or access barriers. Additionally, shared decision-making and individualization should remain central to the referral process, ensuring that patient preferences and circumstances are accounted for. This flexible and tailored approach reflects the general agreement that 'one size does not fit all' and aligns with current guidelines emphasizing personalized care and treatment. ESC guidelines[10] and the American Heart Association (AHA) guidelines[34] advocate for a patient-centred, shared-decision making, multidisciplinary approach to AF care with risk factor management and patient education as key components.

Stepped care offers a framework for managing chronic illnesses by optimizing resource use at the population level. It assumes that care

Table 2 Inclusion criteria in the needs assessment model

Items	Relevance	Inclusion criteria	Possible outcome[a]	Data source[a]
Atrial fibrillation–related symptom burden and decreased quality of life				
High atrial fibrillation related symptom burden	HIGH	HIGH	HIGH	PRO, PI, C
Atrial fibrillation related decreased quality of life	HIGH	MODERATE	HIGH	PRO, PI
Risk factors—lifestyle and comorbidities				
Obesity	HIGH	HIGH	MODERATE	R, C
Physical inactivity	HIGH	HIGH	HIGH	PRO, PI
Smoking	HIGH	MODERATE	HIGH	PRO, PI
Alcohol consumption/over-consumption	HIGH	MODERATE	HIGH	PRO, PI
Sleep apnoea	HIGH	MODERATE	No	PRO, PI, R, C
Hypertension	HIGH	HIGH	MODERATE	R, C
Diabetes/pre-diabetes	HIGH	MODERATE	MODERATE	R, C
Other cardiac diseases (cardiac comorbidity)	HIGH	MODERATE	NA	R, C
Psychosocial factors				
Anxiety	HIGH	MODERATE	HIGH	PRO, PI
Self-management abilities				
Medicine non-adherence	HIGH	LOW	MODERATE	PI, R
HIGH consensus: ≥ 75% consensus of the status of the item.				
MODERATE consensus: 50–74% consensus of the status of the item.				
LOW consensus: 25–49% consensus of the status of the item.				

PRO, 'Patient-Reported Outcomes', based on validated questionnaires; PI, 'Patient Interview'; R, 'Patient Record Data'; C, 'Clinical assessment', evaluated by a health professional; NA, not applicable.
[a]Only reported results ≥50% consensus in these colloums.

needs vary between individuals, the right level of care depends on outcome monitoring, and escalating from lower to higher care levels based on outcomes enhances effectiveness and reduces costs.[39] A stepped-care approach could be implemented for AF management, tailored to individual needs, ranging from recognizing challenges and suggesting self-management strategies, to referral for primary care interventions, and if necessary more specialized AF treatment. This approach ensures that most individuals receive CR tailored to their specific needs and at the same time optimizing use of resources.[39] This aligns well with the consensus meeting discussion on the severity and burden of disease. It was noted during the consensus meeting that not all individuals with AF might need the entire comprehensive intervention. Therefore, it is important to differentiate and personalize care efforts. This is especially relevant as the number of individuals diagnosed with AF is expected to increase,[8] alongside the constraints of limited healthcare resources.[40] Consequently, prioritizing the use of these resources will become increasingly important.

Strengths

This Delphi study has several strengths. First, a large international expert panel in the field of AF care and treatment was involved in the Delphi process. Purposive sampling and snow-balling strategies were used to ensure a wide and relevant inclusion of experts from various disciplines and healthcare sectors. Second, the experts highlighted the Delphi method as interesting and helpful, noting that the process was professionally conducted at a high level of AF management. The experts confirmed that the selected needs assessment criteria were valuable, relevant, and important. Third, the process included a combination of survey rounds and an online consensus meeting, where findings could be discussed in detail before reaching a final consensus and reporting the results. Fourth, the iterative nature of the Delphi process is a strength to using this method as well as having pre-defined criteria for reaching consensus. Fifth, non-responders from the first round were sent the second round of voting. Sixth, there was stringent reporting according to the established ACCORD guidelines.

Limitations

This study also had several limitations. First, the generalizability of the results to other parts of the world may be limited as the experts were primarily from Western high-income countries, with minimal invitation of experts from middle-to-low-income countries. This also limits the global generalizability. Second, there was some attrition during the rounds, with an overall drop-out of 30 out of 69 experts (43.5%) across the three online rounds. There was no clear pattern in the drop-out: A few more women than men dropped out, primarily from academic research or secondary care. As shown in supplementary material online, *Table S4*, 56% of the physicians ($N = 15/27$) remained in the study, which was somewhat lower than for nurses 70% ($N = 16/23$) and 'others' 63% ($N = 12/19$). Whilst some level of attrition is expected in a multi-round consensus process, the drop-out may have influenced the robustness of the consensus achieved by reducing the diversity of perspectives and potentially lead to an over-representation of views from participants who remained engaged. However, the high level of agreement from round 1 regarding the relevance, where most experts participated, suggests that the conclusions reflect a broad expert agreement. Nonetheless, the dropout may limit the generalizability of the findings. Third, a potential limitation is the risk of selection bias in the composition of the expert panel. While we defined the inclusion criteria to ensure a diverse range of perspectives, the lack of objective measures or standardized assessments of expertise may have

Table 3 Important information for the overall assessment

Items	Relevance	Important information	Possible outcome[a]	Data source[a]
Risk factors—lifestyle				
Physical over-activity (physical activity at a professional elite level)	MODERATE	MODERATE	No	PRO, PI
Psychosocial factors				
Depression	MODERATE	MODERATE	MODERATE	PRO, PI
Stress	HIGH	MODERATE	No	PRO, PI
Loneliness	MODERATE	MODERATE	No	PRO, PI
Social vulnerability	MODERATE	MODERATE	No	PRO, PI
Family relations (ex the presence of near family relatives)	MODERATE	HIGH	No	PRO, PI
Other psychiatric disorders	LOW	HIGH	No	PI, R
Self-management abilities				
Medicine non-adherence	HIGH	LOW	MODERATE	PI, R
Health literacy	HIGH	MODERATE	MODERATE	PRO, PI
Motivation for prevention or rehabilitation	HIGH	MODERATE	MODERATE	PRO, PI
Self-assessed need for prevention or rehabilitation	HIGH	MODERATE	NA	PRO, PI
Self-assessed ability to cope well without prevention or rehabilitation	MODERATE	MODERATE	NA	PRO, PI
Language (lack of ability to understand and speak the language)	HIGH	MODERATE	NA	PI
Risk factors—comorbidities				
Metabolic diseases	MODERATE	HIGH	NA	PI, R, C
Cancer	MODERATE	HIGH	NA	PI, R
Chronic obstructive pulmonary disease	HIGH	MODERATE	NA	PI, R
Kidney disease	MODERATE	HIGH	NA	R
Liver disease	LOW	MODERATE	NA	R
Osteoarthritis or other rheumatic disease	LOW	HIGH	NA	PI, R
Inflammatory bowel disease	No	MODERATE	NA	PI, R
Anaemia or other blood-related disease	LOW	MODERATE	NA	PI, R
Pain	LOW	HIGH	NA	PRO, PI, R
Stomach ulcers	LOW	MODERATE	NA	PI, R
HIV/AIDS	LOW	MODERATE	NA	PI, R
Dementia	MODERATE	LOW (or exclusion)	NA	PI, R, C
Allergy	LOW	LOW	NA	PI, R

HIGH consensus: ≥ 75% consensus of the status of the item.
MODERATE consensus: 50–74% consensus of the status of the item.
LOW consensus: 25–49% consensus of the status of the item.

C, 'Clinical assessment', evaluated by a health professional; NA, not applicable; PI, 'Patient Interview'; PRO, 'Patient Reported Outcomes', based on validated questionnaires; R, 'Patient Record Data'.
[a]Only reported results ≥50% consensus in these columns.

introduced variability in the level of expertise among experts. More formal validation of expertise could have enhanced the transparency and reproducibility of the selection process. Also, the approaches of purposive sampling and snow-balling meant that experts were found within networks, i.e. many of the participants knew each other making other potential experts underrepresented. Fourth, we did not pre-define actions for non-response and handled non-response as we progressed through the study, leading us to follow-up on missing participation between round two and three. Fifth, as the surveys were lengthy and time-consuming, the experts expressed that it was challenging to remember evaluation definitions presented at the beginning of the survey when getting further into the item pool. This could potentially cause information bias. Items were categorized from obviously important to less obviously important, to aid in responses. However, this could also be a limitation as it could have led to more automatic answering, which could also be a cause of information bias. Sixth, the definition of consensus was broad with three levels of consensus, possibly diluting the robustness of the conclusions. However, the final needs assessment model only included the 12 criteria which gained a high relevance consensus level (≥75%). Seventh, no inferential statistical analyses were conducted to compare potential subgroup differences and only descriptive sub-group analyses were applied. However, the study and the Delphi method aims to achieve expert consensus rather than test specific hypotheses, and the sample size within subgroups in this study was not sufficient for statistically powered analyses. Therefore, we relied on descriptive statistics and predefined consensus thresholds.

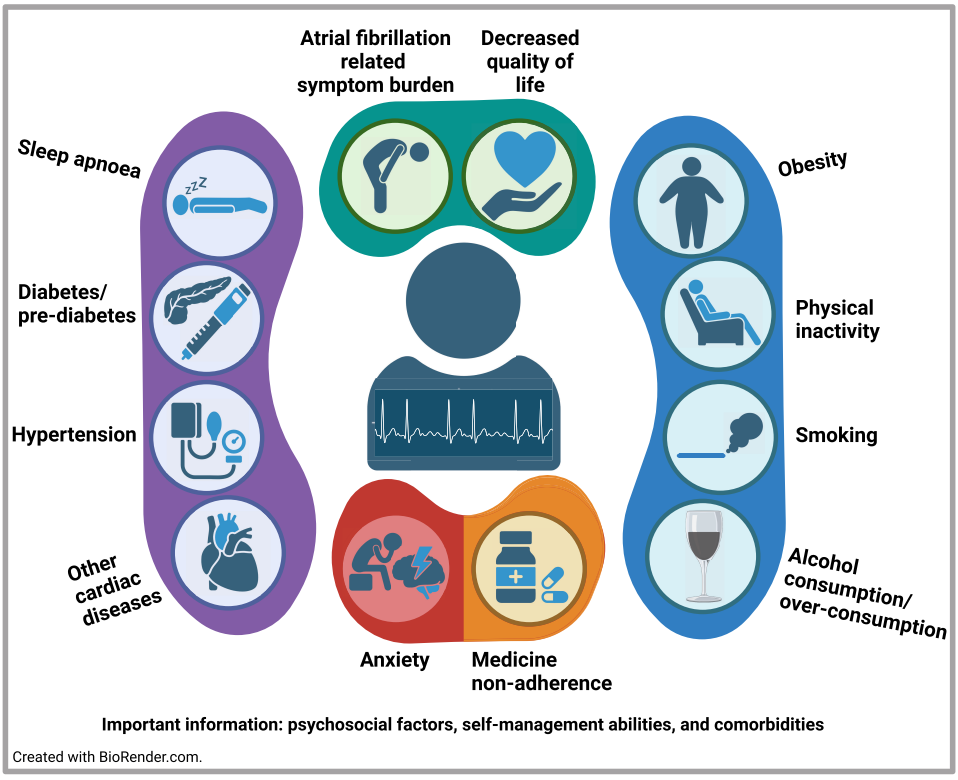


Figure 3 Inclusion criteria in the generic, consensus-based, needs assessment model for individuals with atrial fibrillation.

Eighth, as expert views on referral may be influenced by professional sub-group, the type of national healthcare system, and approach to AF care, it would have been interesting to perform sensitivity analyses grouping experts. This was not possible in this study due to lack of statistical power and potentially complicates the uniform application of the criteria across diverse clinical settings. Finally, while we emphasized adaptability of the model, the absence of clear, practical guidance on local adaptation could pose challenges for immediate clinical application.

Implications for practice and suggestions for future research

To our knowledge, the generic needs assessment model developed in this study is the first of its kind. It provides a foundation for a more structured approach to addressing needs, potentially leading to more equitable referral by moving beyond the current reliance on subjective judgments. The model is intended for future feasibility testing and potential improvements. Future research should also focus on identifying specific measurement tools and thresholds for each criterion, as well as establishing consensus on the number of criteria for referral and their classification. Precise metrics, thresholds, and classifications will enhance the model's accuracy and ensure greater clinical relevance. Additionally, an international mapping of referral practices is essential to identify best practices and areas for improvement. In terms of the global relevance, future research should also explore how this needs assessment model can be adapted to different healthcare settings, particularly in resource-limited environments. This may involve adaptations based on local disease burden, exploring alternative rehabilitation pathways, and identification of practical implementation strategies in settings with limited care options.

Conclusion

In this Delphi process, the expert panel reached consensus on a systematic needs assessment model for CR among individuals with AF. The model is a foundation for more structured needs assessment. More research in this area is warranted to refine the model and ensure effective and equitable implementation of CR for individuals with AF.

Supplementary material

Supplementary material is available at *European Journal of Preventive Cardiology*.

Acknowledgements

We would like to thank Anton Pottegaard (Denmark) for inspiring us with the idea to conduct an international Delphi process. Moreover, we would like to thank all experts who participated in the study, with special appreciation to those who consistently responded to the surveys. A special thanks to Hein Heidbuchel (Belgium) and additional Danish participants: Andi Albertsen, Anja Skov, Anne-Marie Hedegaard, Claus Tveskov, Dagmar Lybak Sieg, Jesper Eilsø, Jonas Bjerring Olesen, Kirsten Gerholt, Louise Huang Juul, Margit Brinck, Robert Bedsted, and Ulla Dam-Schmidt for their valuable inputs during the development of the assessment model.

Author contribution

All authors qualify for authorship according to the ICMJE criteria. The CRediT taxonomy is used to describe contributions to the authorship in the main writing group consisting of C.M.E., S.S.R., B.B., M.B., A.-D.Z., and A. Brandes. C.M.E.: Conceptualization, methodology, project administration, resources, data curation, investigation, formal analysis, visualization, funding acquisition, writing—original draft, writing—review and editing. S.S.R.: Conceptualization, methodology, investigation, formal analysis, visualization, supervision, writing—original draft, writing—review and editing. B.B.: Investigation, supervision, writing—review and editing. M.B.: Conceptualization, investigation, supervision, writing—review and editing. A.-D.Z.: Conceptualization, methodology, investigation, formal analysis, funding acquisition, visualization, supervision, writing—original draft, writing—review and editing. A. Brandes: conceptualization, methodology, investigation, formal analysis, funding acquisition, visualization, supervision, writing—original draft, writing—review and editing. The extended author group consisting also of: A.M.J., A. Bovin, A.M.B.S., B.C., D.A.L., D.A., E.S., G.Y.H.L., I.K., J.A., J.S.H., J.M.H., J.C.L.H., J.D., K.W., L.D., L.O., L.V., L.N., M.P., M.D.Z., S.M.R., and T.M. specifically contributed with reviewing and commenting on the manuscript. In this process, the extended author group took part in interpreting the data. All have provided final approval of the version to be published and agreed for the accountability of all aspects of the work (as according to the ICMJE criteria).

Funding

This project is part of a PhD study, which is partially funded by a PhD faculty scholarship from the University of Southern Denmark (no Grant number), a PhD scholarship from the Region of Southern Denmark (grant number: J.no.: 21/58092), and the fund to support independent, strategic clinical research in the Region of Southern Denmark (grant number: J.no.: 2024-0022).

Conflict of interest: J.S.H. received research Grants and speaking fees from Boston Scientific, Medtronic and BMS/Pfizer outside the submitted work. I.K. received lecture fees from Pfizer and Boehringer Ingelheim outside the submitted work. D.A.L. received investigator-initiated quality improvement grants from Bristol-Myers Squibb and Pfizer, has been a speaker for Bayer, Boehringer Ingelheim, and Bristol-Myers Squibb/Pfizer and has consulted for Bristol-Myers Squibb and Boehringer Ingelheim; all outside the submitted work. She is a co-applicant on the AFFIRMO project on multimorbidity in AF (Grant Agreement No. 899871), ARISTOTELES project on artificial intelligence for management of chronic long term conditions (Grant Agreement No. 101080189), and the TARGET project on digital twins for personalised management of atrial fibrillation and stroke (Grant Agreement No. 101136244), all of which are funded by the European Union Horizon Europe Research & Innovation programme. G.Y.H.L. is a National Institute for Health and Care Research (NIHR) Senior Investigator. He is Consultant and speaker for BMS/Pfizer, Boehringer Ingelheim, Daiichi-Sankyo, Anthos (No fees are received personally). L.N. received lecture fees from Daiichi Sankyo and Sanofi outside the submitted work. E.S. is supported by the Stockholm County Council (Clinical researcher appointment), the Swedish Research Council (DNR 2022-01466), the Swedish Heart and Lung foundation, CIMED, and has received institutional lecture fees/travel support from Abbott, Astra Zeneca, Bristol-Myers Squibb-Pfizer, Johnson & Johnson outside the submitted work. K.W. has received honoraria from both Milestone Pharmaceuticals and AltaThera Pharmaceuticals as an Advisory Panel member; and has received an educational research grant from AltaThera Pharmaceuticals outside the submitted work. A. Brandes received lecture fees from Bristol-Myers Squibb and institutional research grants from Theravance, the Zealand Region, the Canadian Institutes of Health Research, the Danish Heart Foundation, the European Union Interreg 5A Programme, and the Independent Research Fund Denmark outside the submitted work.

Data availability

The datasets analyzed during the current study are available from the corresponding author on reasonable request.

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