



# Electrophysiology fellowship experience and requirements: an EHRA survey

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## Aims

This study aims to survey current educational experience and the individual requirements for electrophysiologists in training.

## Methods and results

The European Heart Rhythm Association (EHRA) e-Communication Committee and the Scientific Initiatives Committee prepared a questionnaire and distributed it via newsletters, Twitter, LinkedIn, and Facebook. The survey consisted of 22 questions collected on an individual basis anonymously. Two hundred and forty-three responders from 35 countries (32% female, age  $38 \pm 6$  years old) completed the survey. This EHRA electrophysiology (EP) fellowship survey showed that (i) hands-on participation and observation of EP procedures are very important; (ii) the main motivations to choose the EP fellowship institution are centre reputation and volume as well as the availability of a structured EP fellowship programme; (iii) 59% passed the EHRA exam and 46% took a national certification exam; (iv) respondents are overall satisfied with their own fellowships, but there are areas of less confidence such as conduction system pacing implantation and cardiac resynchronization therapy implantation; (v) 78% of respondents performed research during their fellowship, (vi) the optimal duration of an EP fellowship should be at least 2 years; and (viii) doing fellowships abroad is beneficial, but significant obstacles exist.

## Conclusion

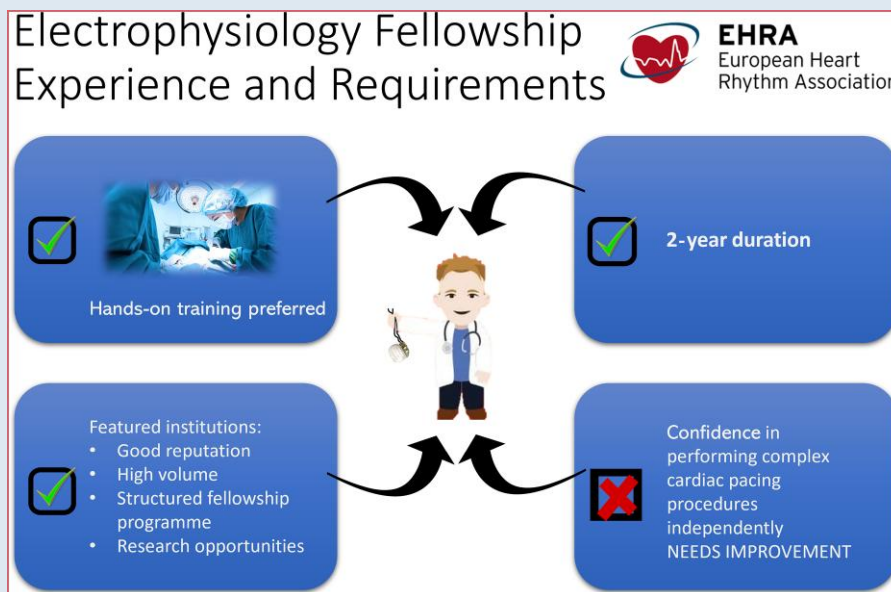
The results of this EHRA survey may help to refine current EP fellowship programmes to improve the quality of EP training and early career building of young electrophysiologists.

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## Graphical Abstract



## Keywords

EP fellowship • Training • Career building • EHRA survey

## What's new?

- Hands-on participation and observation of clinical electrophysiology (EP) procedures are very important.
- The main motivations for the choice of the EP fellowship institution are the centre reputation and volume as well as the availability of a structured EP fellowship programme.
- After a fellowship, the trainees frequently do not feel confident in certain areas such as conduction system pacing or cardiac resynchronization therapy.
- Optimal duration of an EP fellowship should be at least 2 years, if the goal is to cover all facets of EP.
- Doing EP fellowships abroad is beneficial, but significant obstacles exist.

## Introduction

The field of cardiac electrophysiology (EP) is a rapidly growing subspecialty in cardiology, which requires understanding of mechanisms of cardiac arrhythmias to become familiar with different treatment strategies. It includes a wide range of conventional and complex catheter ablation procedures for various cardiac arrhythmias and the implantation and follow-up of cardiac implantable electronic devices. The Accreditation Committee of the European Heart Rhythm Association (EHRA) has previously introduced specific curricula in 2009, defining requirements for both training centres and trainees.<sup>1</sup> However, a recent EHRA survey showed that considerable heterogeneity exists with respect to certification processes and standardized fellowship programmes during the EP training across European Society of Cardiology (ESC) member countries.<sup>2</sup> This may particularly impact career building in countries, where EP centres are not broadly established, yet.<sup>3</sup> Additionally, although the number of catheter ablation procedures is expected to grow, training opportunities are limited, and, depending on national regulations, not all centres fulfil recommended requirements for ablation centres.<sup>4-7</sup>

In this EHRA survey, we assessed the current educational experience and individual requirements and challenges of young electrophysiologists for EP education.

## Methods

To map EP fellowship experience and requirements in several EHRA countries, the EHRA e-Communication Committee and the Scientific Initiatives Committee prepared a questionnaire on SurveyMonkey. The official EHRA website, the EHRA newsletter, and the EHRA Young EP network as well as Twitter, LinkedIn, Facebook and personal mailing lists were used to disseminate the survey among relevant colleagues.

The survey consisted of 22 questions in two blocks (see [Supplementary Material online](#)): The first block consisted of general questions regarding personal information and demographics including gender, age, working position, working environment, and main specialty. The second block assessed the EP fellowship experience and individual requirements and challenges of young electrophysiologist for EP education using Likert scales.

## Statistical analysis

Continuous variables were expressed as mean and standard deviation, and categorical variables were presented as numbers and percentages. Comparisons between groups were performed using Student's t-tests or Mann-Whitney U tests for continuous variables as appropriate and chi-square test for categorical variables. Statistical analysis was performed using SPSS 25.0 for Windows (SPSS Inc., Chicago, IL, USA) and R (R Foundation for Statistical Computing, Vienna, Austria). Values of  $P < 0.05$  (two-tailed) were considered as statistically significant.

## Results

## General characteristics of respondents

The characteristics of respondents are shown in [Table 1](#). Two hundred and forty-three responders from 35 countries (32% female, age  $38 \pm 6$  years old) completed the survey. Of those, 46% were fully trained electrophysiologists, 41% were electrophysiologists in training and 12% were non-electrophysiologists.

In total, 16%, 9%, and 8% of all respondents graduated from universities in Germany, Italy, and Spain, respectively. Additionally, 20%, 9%, and 6% of respondents are currently working in Germany, Italy, and Spain, respectively.

**Table 1** The characteristics of respondents

	Total (n = 243)
<b>Age (years)</b>	38 ± 6
<b>Female</b>	64 (32%); n = 199
<b>Graduated from university (overall top 3)</b>	Germany—32 (16%) Italy—19 (9%) Spain—17 (8%) Other countries—135; n = 203
<b>Country currently practicing medicine (overall top 3)</b>	Germany—41 (20.4) Italy—17 (8.5) Spain—13 (6.4) Other countries—130 (64.7); n = 201
<b>Current professional status</b>	
Fully trained EP	94 (46%)
EP in training	84 (41%)
Non-EP	25 (12%); n = 203
<b>Primary working environment</b>	
University hospital	127 (63%)
Public community hospital	22 (11%)
Private hospital	21 (10%)
Specialised public cardiology centre	30 (15%)
Other	3 (2%); n = 203

EP, electrophysiology.

The majority (62%) of respondents were working in university hospitals; 15% were working in specialized public cardiology centres followed by 10% working in public community hospitals and private hospitals.

## Electrophysiology fellowship: in general

Figure 1 shows what activities the respondents consider to be important in learning EP. The three most important activities are 'performing cases in hospital/hands-on' (88.8%, very important), 'seeing cases in hospital' (74% very important), and 'reading books/literature' (54% very important). 'International educational courses' were considered to be important, followed by 'webinars' and 'industry courses', which ranked both lower.

Respondents were asked to identify benefits (Figure 2A) and challenges/obstacles (Figure 2B) of undergoing an EP fellowship abroad.

The main benefit for the respondents of undergoing an EP fellowship abroad is to get to know another country and to build up a network. Other benefits are related to the level of expertise and availability of a structured fellowship programme not available in their country. All surveyed challenges (finances, family, access to positions, time commitments, and board registrations) have been scored as significant and very significant by the majority (more than 50%) of all respondents.

## Electrophysiology fellowship: own experience

Almost 70% of all respondents have either already completed or are currently partaking in a dedicated EP fellowship programme; 7% focus on implantable cardiac devices, 36% focus solely on EP, and 57% focus on both.

Fifty-nine per cent participated in the EHRA courses/exams, 46% took a national certification exam (69% took a certification exam, either national or EHRA), and 41% of all respondents took part in an educational fellowship programme (most organized by industry).

The main motivations for the choice of the fellowship institution were the reputation and volume of the centre, followed by the availability of a structured fellowship programme and research opportunities in the centre. Personal reasons are mentioned as well but were considered weaker on the motivation scale (Figure 3A).

The respondents were overall satisfied with their fellowships. Activities in invasive EP and basics in EP particularly fulfilled the expectations in about 80% of all respondents. Activities in non-invasive EP and cardiac pacing were satisfactory for 70% of all respondents (Figure 3B).

This was also reflected in the question regarding the trainees' confidence in performing procedures independently after the fellowship. The respondents feel secure in diagnostic EP procedures, interventional EP procedures, cardiac pacing procedures, and checks/programming of cardiac devices. However, they expressed an ongoing lack of confidence in conduction system pacing and cardiac resynchronization therapy implantation.

Almost 80% of respondents performed research during their fellowship. Most of them performed clinical research (77.4%), while only 4.1% performed basic science research. Less than 20% of respondents performed both, clinical and basic science research.

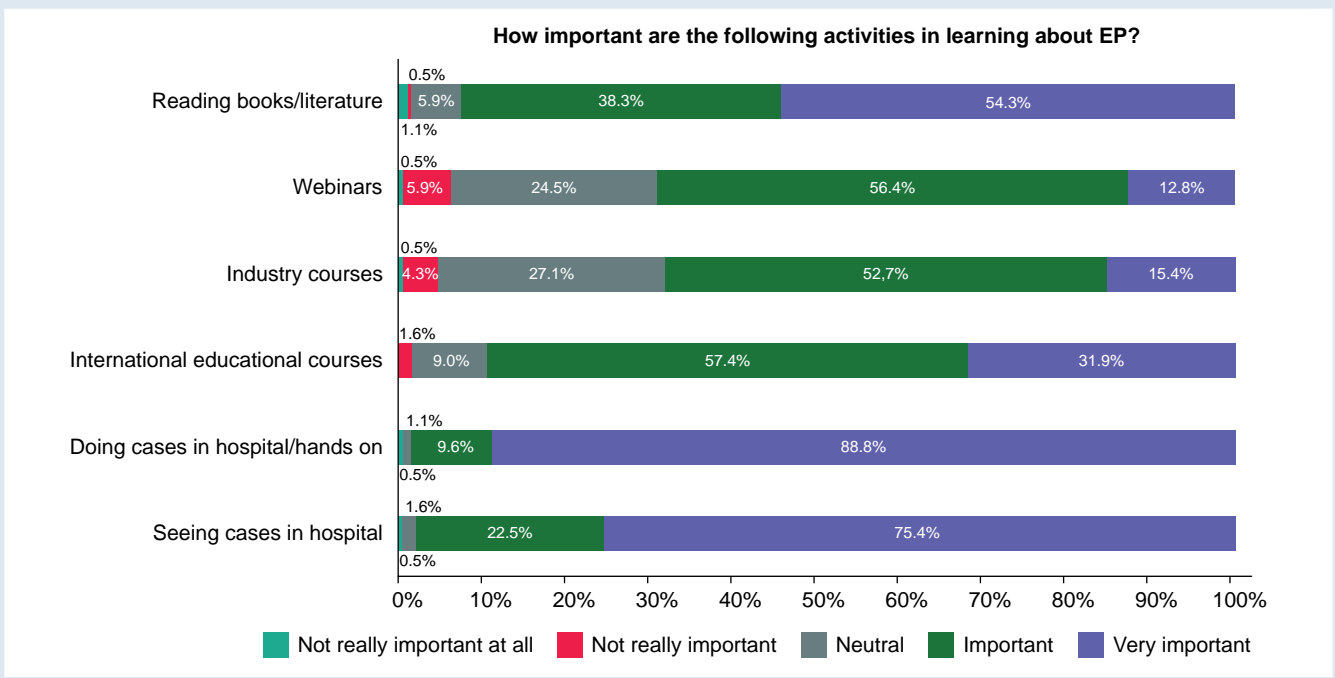
An EP fellowship should be at least 2 years with 12 months focus on invasive EP, 7–12 months focus on cardiac pacing, and 3–6 months focus on non-invasive cardiac EP, if the goal is to cover all facets of EP (Figure 4).

## Discussion

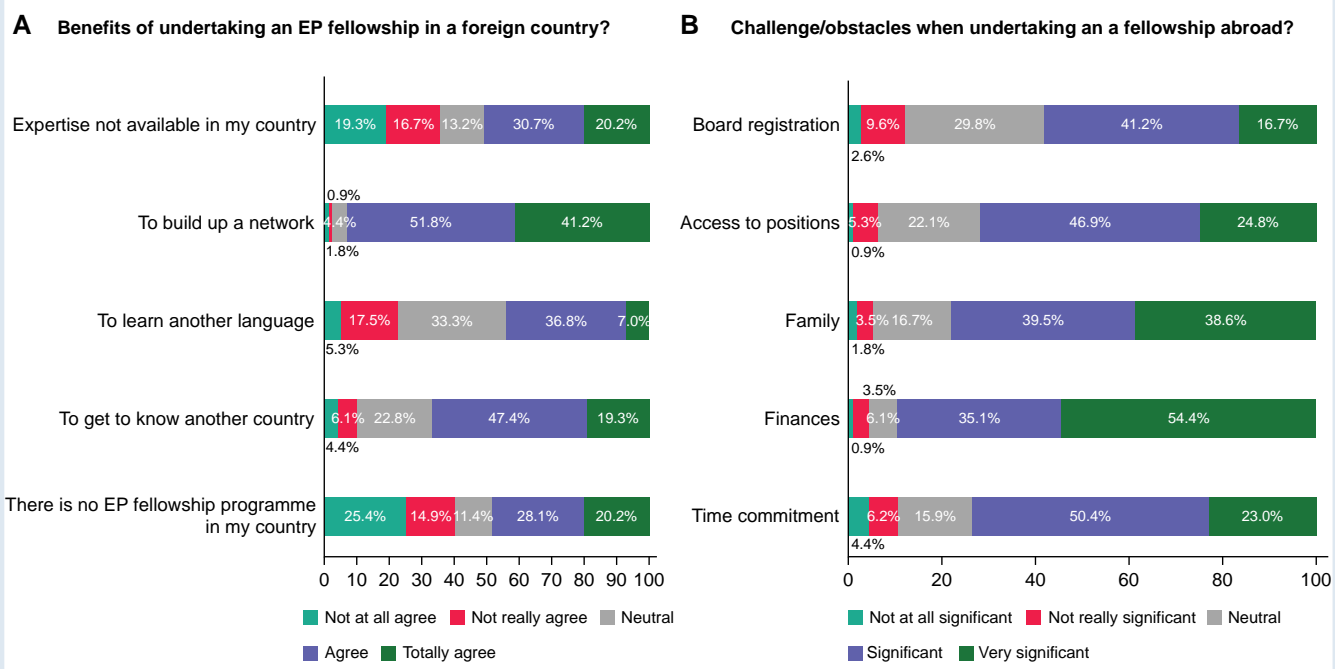
The main findings of this EHRA fellowship survey are as follows:

- (1) Hands-on participation and observation of EP procedures are very important.
- (2) The main motivations for the choice of the fellowship institution are the reputation and volume of the centre, as well as the availability of a structured fellowship programme.
- (3) The majority of respondents participated in the EHRA exam and/or took a national certification exam.
- (4) Respondents are overall satisfied with their fellowship. However, a degree of lack of confidence in certain areas of complex cardiac pacing procedures remains after the completion of the fellowship.
- (5) The majority of respondents performed research during their fellowship. But just 4.1% performed purely basic science research and 18.6% performed basic science research in combination with clinical research.
- (6) The optimal duration of an EP fellowship should be a bit above 2 years, if the goal is to cover all facets of EP.
- (7) Doing fellowships abroad is beneficial, but significant obstacles exist.

The results of this survey indicate that the most preferred way of learning EP is hands-on participation and observation of EP procedures, ideally in high-volume centres with a good reputation. In addition to the active and passive involvement in clinical cases and procedures, educational programmes are also used widely. A previous ESC survey showed considerable heterogeneity with respect to certification processes and standardized fellowship programmes during the EP training.<sup>2</sup> Our survey shows that most of the trainees voluntarily take the certification exam by EHRA or their national societies. Of note, besides the EHRA courses/exams and national courses, which are completed by 69%, a large proportion of fellows also participated in industry-sponsored educational courses. Although these industry-sponsored educational courses were established by the wider EP community, the role and responsibility of scientific societies such as EHRA in the delivery and quality of this form of training should be further explored. Additionally, the digital and social media transformation of cardiac EP



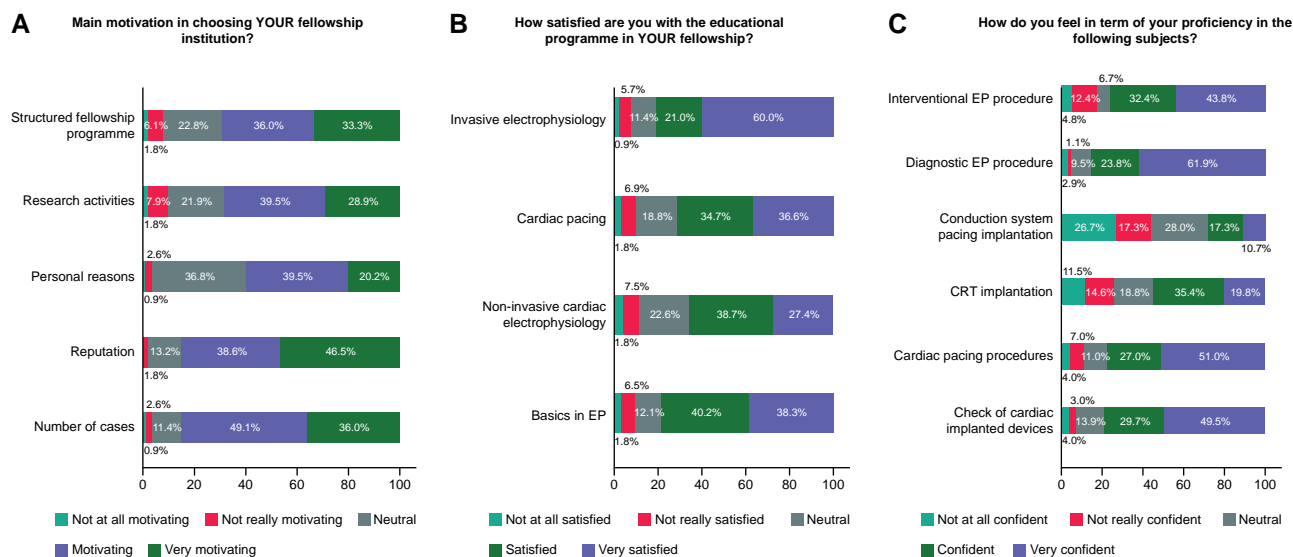
**Figure 1** Preference ratings for each single activity to learn about EP. Ratings ranged from 'not very important' to 'very important'. EP, electrophysiology.



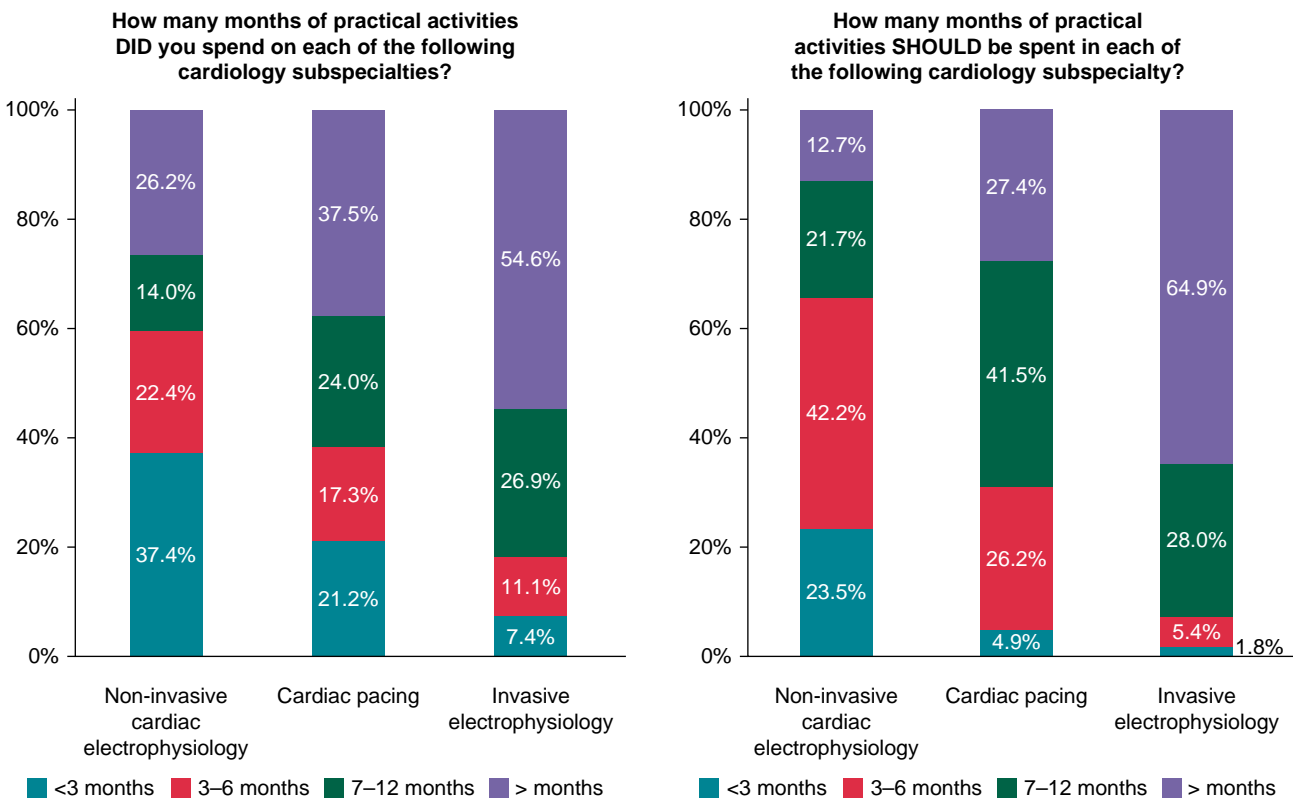
**Figure 2** (A) Preference ratings for each benefit of undertaking an EP fellowship abroad. Ratings ranged from 'not at all agree' to 'totally agree'. (B) Preference ratings for each challenge/obstacle when undertaking an EP fellowship abroad. Ratings ranged from 'not at all significant' to 'totally significant'. EP, electrophysiology.

education has revolutionized the way education is currently delivered by hybrid in-person and virtual modalities providing electrophysiologists with the flexibility to choose the best option to suit their individual

needs and preferences for continuing education.<sup>8-10</sup> On top of a theoretical evaluation, such the one performed by the EHRA exam, also a practical evaluation, which should be not just focus on time and the



**Figure 3** (A) Preference ratings for each motivation in choosing a fellowship institution. Ratings ranged from ‘not at all motivating’ to ‘very motivating’. (B) Preference ratings for satisfaction in each facet of an EP fellowship. Ratings ranged from ‘not at all satisfied’ to ‘very satisfied’. (C) Preference ratings for confidence/proficiency in each subject of an EP fellowship. Ratings ranged from ‘not at all confident’ to ‘very confident’. CRT, cardiac resynchronization therapy; EP, electrophysiology.



**Figure 4** Duration of an EP fellowship. EP, electrophysiology.

number of procedures, but also on the assessment of skills, might make sense.<sup>11</sup> The EHRA is offering different types and levels of training and education opportunities such as webinars and simulation village at the EHRA Congress 2023. Additionally, also simulator training may significantly improve the independent trainees' performance, particularly during the early phase of the trainees' learning curve.<sup>12</sup>

Another interesting result was that research is frequently incorporated in the EP fellowships. The largest proportion of respondents focused on clinical research, while basic science research was just performed by a minority. This is in line with a recent EHRA survey on research activities.<sup>13</sup> Therefore, centres providing EP fellowship positions should also facilitate access to a supportive research environment, to ensure the most optimal output of the research activities during an EP fellowship.

Overall, respondents were satisfied with their own fellowship; however, a majority of respondents did not feel confident in performing interventional EP and device implantation (particularly cardiac resynchronization therapy and conduction system pacing implantation). This finding has been already shown in other national surveys before.<sup>7</sup> While the conduction system pacing is a growing field and one may argue that there are few centres that are actual experts, cardiac resynchronization therapy has been around for years and there is no reason why the teaching of these techniques should be insufficient during training. Based on our EHRA survey, an EP fellowship should be at least 2 years with 12 months focus on invasive EP, 7–12 months focus on cardiac pacing, and 3–6 months focus on non-invasive cardiac EP, if the goal is to cover all facets of EP.

The EHRA provides support through the 'EHRA Training Fellowships' and the 'EHRA Observational Training Program' focusing on clinical EP with emphasis on catheter ablation and cardiac pacing with emphasis on implantable cardioverter defibrillator/cardiac resynchronization therapy. These programmes are offered to allow physicians to gain specialized training in clinical EP in an ESC member country preferably outside their home country, for example in the EHRA Recognised Training Centers (ERTC) (<https://www.escardio.org/Education/Career-Development/Grants-and-fellowships/EHRA-training-fellowships>). However, as indicated in previous surveys, training opportunities are limited in many EHRA countries [mean number of centres accredited for EP training per country was  $10 \pm 31$  (range 0–149)].<sup>7</sup> Additionally, although respondents see benefit in doing their EP fellowship abroad in a country, where training positions are available, several obstacles exist. The EHRA can play an active and important role in ensuring access to training in EP and cardiac pacing. Also, participation in an educational programme such as the 'Diploma of Advanced Studies in Cardiac Arrhythmia Management' (DAS-CAM) may provide opportunities to build networks, which has been mentioned as one of the main benefits of undergoing an EP fellowship abroad.

The EHRA Certification Committee has previously introduced a specific curriculum in 2009, defining requirements both for training centres and trainees.<sup>1</sup> Currently, a committee from the EHRA Certification Committee is updating the EHRA core curriculum. The new version will be presented at EHRA 2024.

## Limitations

As it is the case for all surveys, there might be a responder bias that cannot be neglected. Moreover, the respondent's geographical distribution is focused on Europe with EHRA countries as the main source of replies. Therefore, caution should be made in generalizing the results of the present survey to other regional settings.

## Conclusions

This EHRA fellowship survey showed that (i) hands-on participation and observation of EP procedures are very important; (ii) the main

motivations to choose a fellowship institution are the reputation and volume of the centre as well as the availability of a structured EP fellowship programme; (iii) the majority of respondents took the EHRA exam and/or took a national certification exam; (iv) lack of confidence upon completion of an EP fellowship remains in performing conduction system pacing and cardiac resynchronization therapy implantation independently; (v) the majority of respondents performed research during the fellowship; (vi) the optimal duration of an EP fellowship should be above 2 years; and (vii) doing fellowships abroad is beneficial, but significant obstacles exist. The results of this EHRA survey, including own experiences and expectations, may help to refine current EP fellowship programmes to improve the quality of EP training and early career building of young electrophysiologists.

## Supplementary material

Supplementary material is available at *Europace* online.

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## Data availability

Data available on request.

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