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EHRA SURVEY

EHRA European Heart Rhythm Association

Utilization of and perceived need for simulators in clinical electrophysiology: results from an EHRA physician survey

Fleur V.Y. Tjong [1†], Laura Perrotta [2*†], Andreas Goette [3], David Duncker [4], Kevin Vernooy [5], Serge Boveda [6], Kyoung-Ryul Julian Chun [7], and Emma Svennberg [8]

[1]Heart Center, Department of Cardiology, Amsterdam UMC, Location AMC, University of Amsterdam, Amsterdam, The Netherlands; [2]FEHRA, Arrhythmia Unit, University Hospital Careggi, EP Lab, Largo Brambilla 3, 50134 Florence, Italy; [3]FEHRA, Department of Cardiology and Intensive Care Medicine, St Vincenz Hospital, Paderborn, Germany; [4]FEHRA, Hannover Heart Rhythm Center, Department of Cardiology and Angiology, Hannover Medical School, Hannover, Germany; [5]FEHRA, Department of Cardiology, Cardiovascular Research Institute Maastricht (CARIM), Maastricht University Medical Center, Maastricht, The Netherlands; [6]FEHRA, Cardiology—Heart Rhythm Management Department, Clinique Pasteur, Toulouse, France; [7]FEHRA, CCB, Cardiology, Med. Klinik III, Markuskrankenhaus, Frankfurt, Germany; and [8]FEHRA, Department of Medicine Huddinge, Karolinska Institutet, Karolinska University Hospital Huddinge, Stockholm, Sweden

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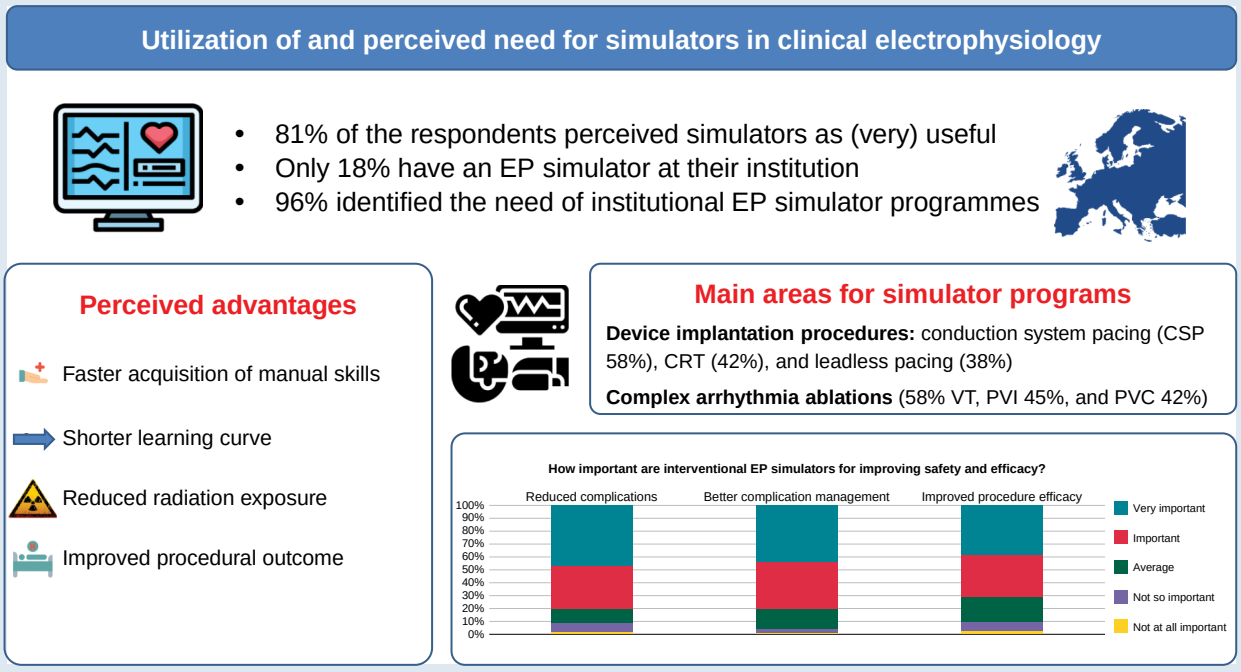
Aims Simulator training has been recently introduced in electrophysiology (EP) programmes in order to improve catheter manipulation skills without complication risks. The aim of this study is to survey the current use of EP simulators and the perceived need for these tools in clinical training and practice.

Methods and results A 20-item online questionnaire developed by the Scientific Initiatives Committee of the European Heart Rhythm Association (EHRA) in collaboration with EHRA Digital Committee was disseminated through the EHRA Scientific Research Network members, national EP groups, and social media platforms. Seventy-four respondents from 22 countries (73% males; 50% under 40 years old) completed the survey. Despite being perceived as useful among EP professionals (81%), EP simulators are rarely a part of the institutional cardiology training programme (20%) and only 18% of the respondents have an EP simulator at their institution. When available, simulators are mainly used in EP to train transseptal puncture, ablation, and mapping, followed by device implantation (cardiac resynchronization therapy [CRT], leadless, and conduction system pacing [CSP]). Almost all respondents (96%) believe that simulator programmes should be a part of the routine institutional EP training, hopefully developed by EHRA, in order to improve the efficacy and safety of EP procedures and in particular CSP 58%, CRT 42%, leadless pacing 38%, or complex arrhythmia ablations (VT 58%, PVI 45%, and PVC 42%).

Conclusion This current EHRA survey identified a perceived need but a lack of institutional simulator programme access for electrophysiologists who could benefit from it in order to speed up the learning curve process and reduce complications of complex EP procedures.

* Corresponding author. Tel: +390557947623. *E-mail address*: lauraeplab@gmail.com
† The first two authors contributed equally to the study.

Graphical Abstract



Keywords EP simulators • Training • EHRA survey • Young electrophysiologists

What's new?

- Simulators have been shown to provide realistic training in several procedural medical specialities.
- Simulators in EP may potentially enhance quick manual skill improvement without exposing patients to complication risks.
- Despite being considered very useful among EP professionals, EP simulators are rarely available at EP institutions and are not part of the institutional cardiology training.
- A European Heart Rhythm Association EP simulator programme should be a part of routine institutional EP training, in order to improve the efficacy and safety of EP procedures.

Introduction

Traditional fellowship training in electrophysiology (EP) currently relies on an apprentice/master model combining deep knowledge of theoretical aspects of heart rhythm disease and long learning curve to develop and improve manual skills.[1] Besides an extensive comprehension and interpretation of EP electrograms and arrhythmias physiology (mechanism), EP fellows are also required to learn all the technical aspects of EP procedures through 'hands-on' practice under the supervision of a 'senior' electrophysiologist.

This process is time-consuming and sometimes frustrating for both the young trainee operator and the senior electrophysiologists; since during this learning curve period, performances are often suboptimal and may expose the patient to an increased risk of complications[2] or to a higher dose of radiation.[3,4]

In addition, with a growing number and complexity of EP procedures observed recently, quick and complete training has become even more demanding for EP fellows.

Previous studies reported that simulators have been shown to provide realistic training in several procedural medical specialties and lately also in EP, demonstrating the advantage of fast acquisition of manual skills without encountering adverse patient outcomes and reducing radiation exposure.[5–11]

Simulators are well-recognized tools used in learning anatomy, radiology imaging,[12–14] or surgical intervention, like endotracheal intubation or laparoscopic procedures.[15–18]

The US Accreditation Council for Graduate Medical Education indicated simulation training was mandatory during cardiology training, and even the Society for Cardiovascular Angiography and Interventions recommended it.[6] In Europe, similar programmes are not currently integrated during the institutional training at the school of medicine or in the speciality training.

Procedural outcomes in terms of efficacy and reduced complications' rate are clearly related with increased operator's experience and procedure volumes; thus, simulators may be crucial not only to acquire basic manual skills both in EP and cardiac pacing but also especially to address the introduction and development of new technologies.[3,4,8–11] The aim of this survey was therefore to investigate the current use in clinical practice and the perceived need of virtual training in EP across different EP centres.

Methods

A 20-item online questionnaire developed by the Scientific Initiatives Committee of the European Heart Rhythm Association (EHRA) in collaboration with EHRA Digital Committee was disseminated through the EHRA Scientific Research Network members, national EP groups, and social media platforms (Twitter, LinkedIn, and Facebook) between 20 June and 8 July 2022. The questionnaire was anonymous and complied with the European General Data Protection Regulation 2016/679. The survey polled EHRA members on the use of EP simulators in clinical training and practice; and the perceived need in various clinical scenarios. The full questionnaire is provided in the Supplementary material online.

Table 1 Characteristics of survey respondents

Total number of respondents (*n*)	74
Sex	
Male	73%
Female	16%
Not reported	11%
Age (years)	
<30	3%
30–39	47%
40–49	24%
50–59	23%
60–69	2%
≥70	1%
Country	
Austria	4%
Belarus	1%
Bulgaria	1%
Costa Rica	1%
Ecuador	1%
Finland	1%
France	11%
Georgia	1%
Germany	19%
Greece	3%
Israel	1%
Italy	5%
Luxembourg	1%
The Netherlands	4%
Palestine	1%
Poland	14%
Romania	1%
Serbia	1%
Spain	1%
Sweden	3%
Turkey	4%
UK	3%
Not reported	15%
Professional role	
Cardiologist—EP specialist/consultant	60%
EP fellow	18%
Cardiologist	14%
Cardiology fellow	3%
EP/HCK technicians	3%
Cardiac physiologist	1%
Other	1%
Primary working environment	
University hospital	55%
Specialized public cardiology centre	14%
Private hospital/clinic	12%
Public general/district/community hospital	7%
Private practice	1%
Not reported	11%
Number of years worked in field of EP (mean, SD)	10.6 ± 9.9

SD, standard deviation.

Statistical analysis

Data were analysed using descriptive statistical methods. Categorical variables are presented numerically with absolute percentages (%).

All authors met the ICMJE authorship criteria, have read and approved the manuscript, and take full responsibility for the integrity of the data.

Results

Sociodemographic profile and working environment of respondents

A total of 74 respondents from 22 countries (95% ESC member country) completed the survey, with a 70% completion rate.

The characteristics of respondents are shown in *Table 1*: 73% are males and half of them aged below 40 years, whereas 47% were aged 40–59 years, and only 3% were >60 years. Most of the respondents are cardiologists, 60% fully trained EP specialists and 16% EP fellow in training, with a mean of 10.6 years of experience in EP. The primary working environment of the participants is a university hospital (55%), followed by specialized public cardiology centre (14%), private hospital (12%), public general hospital (7%), and private practice (1%).

Current use, accessibility, and exposure to electrophysiology simulators

The large majority of respondents (81%) find simulators in clinical EP useful (47%) or very useful (34%) (*Figure 1*), although only 18% have an EP simulator available at their institution.

If their institution provided an EP simulator, 32% would regularly use it (weekly), 43% occasionally (monthly), and only 20% rarely (yearly).

Similarly, in only 20%, EP simulation is a part of the institutional cardiology training programme.

Conversely, there is large exposure to EP and device simulators provided by manufacturers: with 69% of the respondents already using them and many who were aware of simulator training programmes offered by different companies (61% Medtronic, 53% Abbott, 45% Biosense Webster, 34% Boston Scientific, 28% Biotronik, followed by 8% Farapulse, 3% Simbionix, Stereotaxis, and 3% Ritmus).

The main setting of simulator use is EP for transseptal puncture (59%), ablation (55%), and mapping (50%) techniques; followed by device implantation training [CRT-D/P 41%, leadless pacing 28%, single- or dual-chamber pacing 23%, implantable cardioverter-defibrillator (ICD) 19%, conduction system pacing (CSP) 16%, and lastly access-site closure devices 1%; *Figure 2*].

Perceived usefulness of simulators in clinical electrophysiology and training

The respondents were asked to provide the main fields deemed useful for simulators, showing a significant difference between the perceived need and the actual exposure to such training opportunities (*Figure 2*).

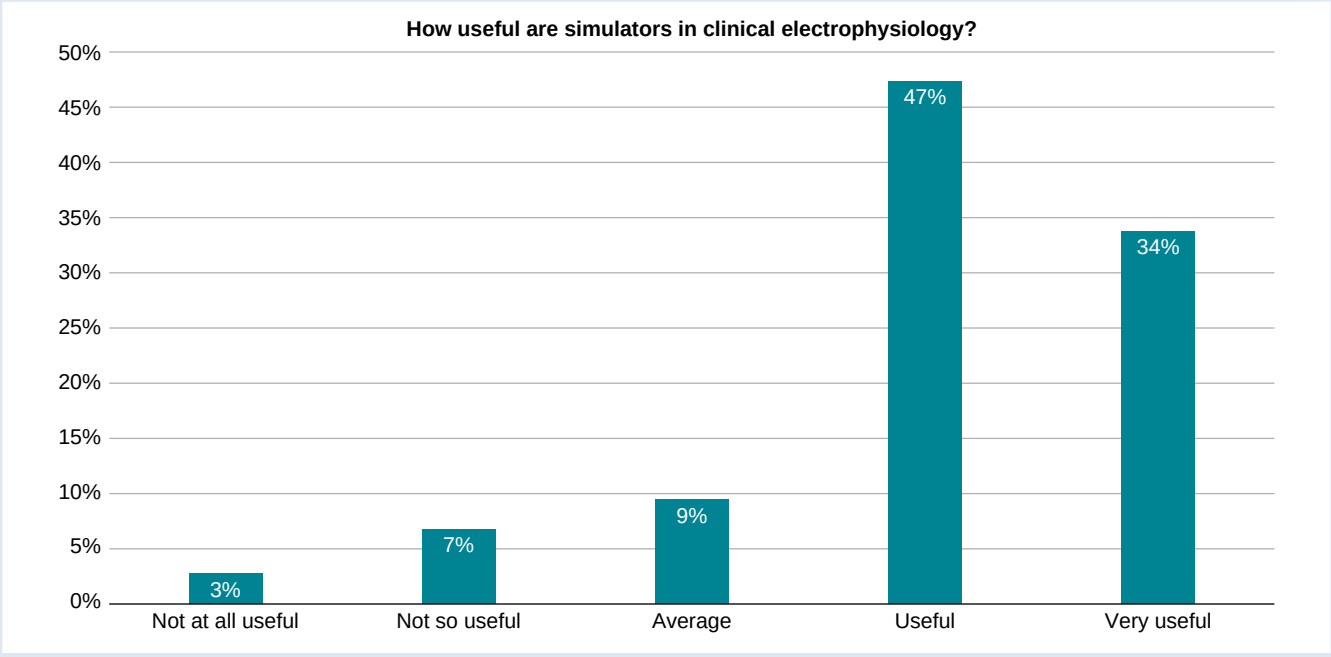


Figure 1 Perceived usefulness of simulators in clinical electrophysiology.

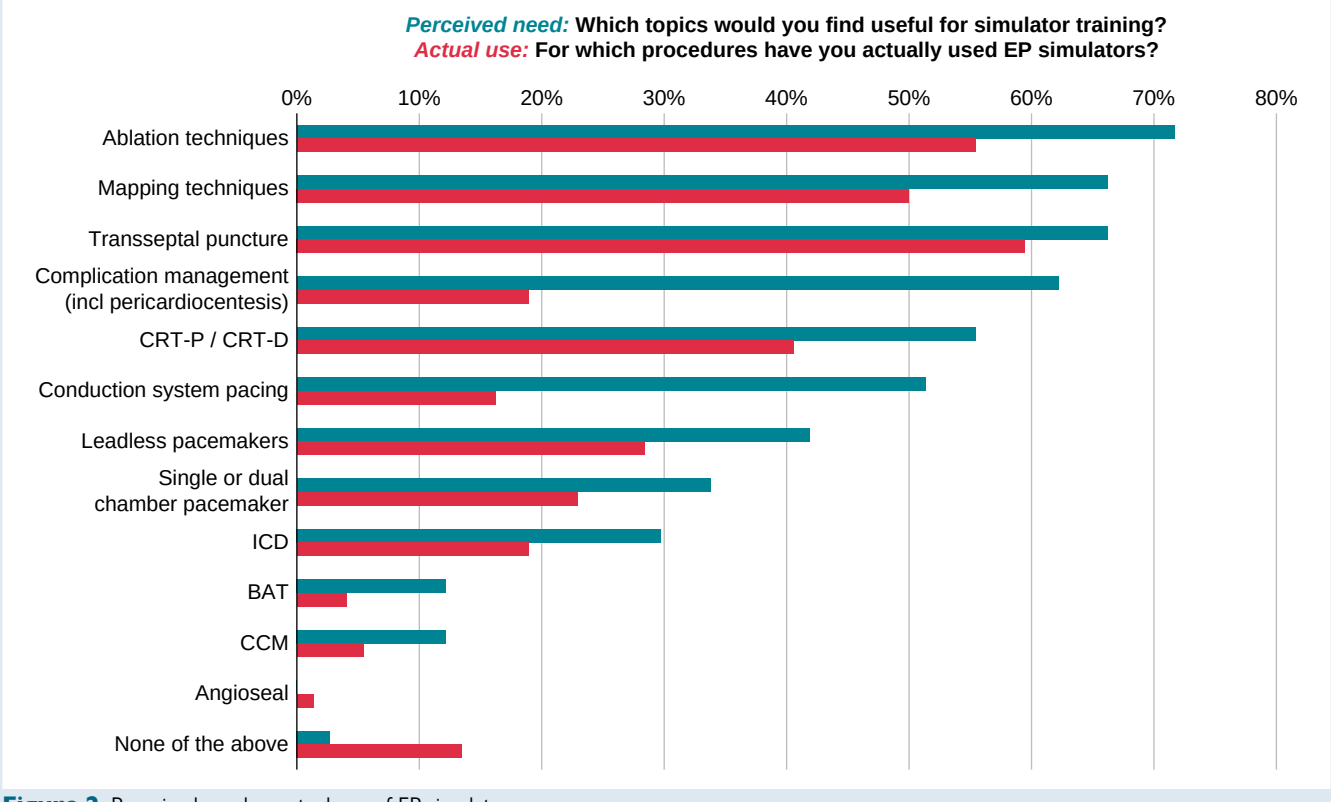


Figure 2 Perceived need vs actual use of EP simulators.

In particular, almost all respondents (96%) believe that EP simulator programmes should be routinely performed by young EPs and should be developed by EHRA, both for EP training (95%) and for continuous education (93%) purposes (*Figure 3*). The main areas of application of a simulator programme should be device implantation procedures such as CSP 58%, cardiac resynchronization therapy (CRT) 42%, leadless pacing 38%, or complex arrhythmia ablations (VT 58%, PVI 45%, and PVC 42%; *Figure 4*).

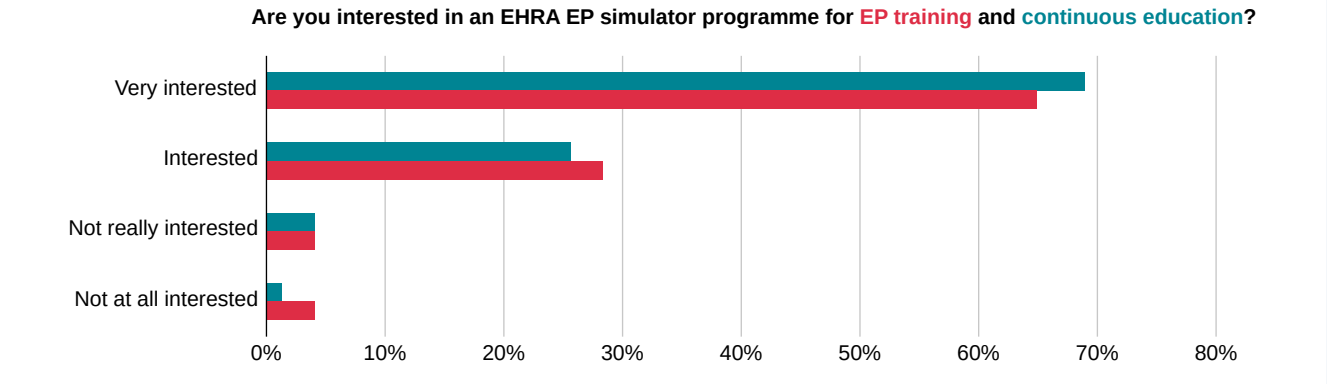


Figure 3 Need of EP Simulator programme developed by EHRA and for continous education purposes.

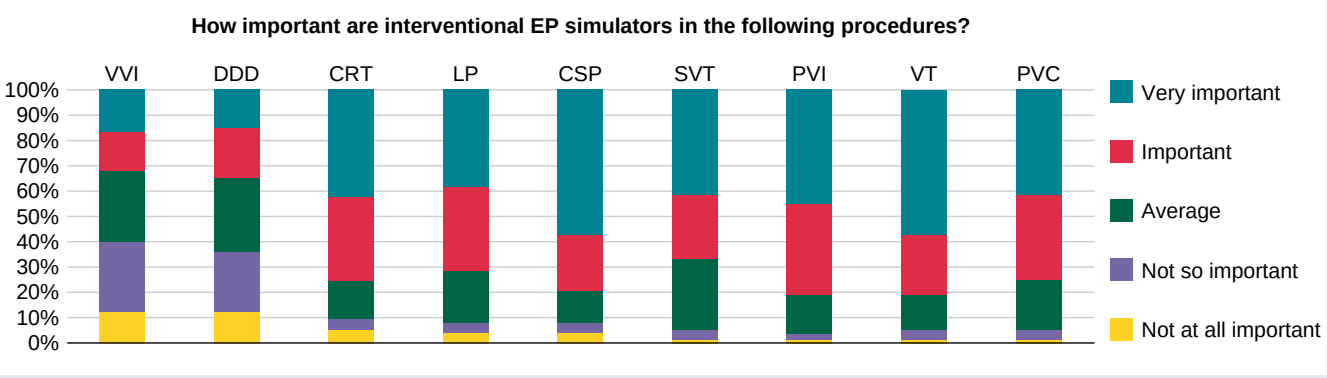


Figure 4 Usefulness of EP simulators in different procedures. CRT, cardiac resynchronization therapy; CSP, conduction system pacing; DDD, dual-chamber pacemaker; LP, leadless pacing; PVC, premature ventricular complex; PVI, pulmonary vein isolation; svt, supraventricular tachycardia; VT, ventricular tachycardia; VVI, single-chamber pacemaker.

The respondents are concordant that the presence of simulator training would not only increase procedure efficacy, but also mainly increase safety by reducing complications and improving their management (*Figure 5*).

Discussion

This EHRA survey focused on the current use of simulators in clinical practice and as a part of institutional training programmes.

The main findings are:

(1) EP simulators are considered useful among EP professionals (81%).
(2) However, only 18% have an EP simulator available at their institution.
(3) EP simulator programmes are rarely a part of the institutional cardiology training programme and are often offered by manufacturers.
(4) When available, simulators are mainly used in EP to train transseptal puncture, ablation, and mapping, followed by device implantation (CRT-D/P, leadless, and CSP).
(5) Almost all respondents (96%) believe that simulator programmes should be a part of the routine institutional EP training and specific structured trainings should be developed by EHRA.
(6) The main areas of application of a simulator programme should be device implantation procedures such as CSP, CRT, leadless pacing, and complex arrhythmia ablations.
(7) The presence of simulator training would not only increase procedure efficacy, but also mainly enhance safety by reducing complications and improving their management.

The results of the survey pointed out the lack of specific simulator-based training provided by institutions for EPs in their training phase.

Virtual simulations have been shown to improve performance and knowledge in many medical settings, such as learning and exploring anatomy and radiology imaging,[12–14] or for some surgical intervention, such as endotracheal intubation or laparoscopic procedures.[15–18]

Similarly, in interventional cardiology, the use of simulators has also been recently recommended by the Society for Cardiovascular Angiography and Intervention's Simulation Committee[6] for both imaging and interventional purposes.[19,20]

However, this survey showed that despite being considered useful by the majority of the respondents, simulators are not routinely available in the EP laboratory.

Previous studies reported the valuable role of this virtual training in the EP field, especially in the early phase of the learning curve of EP procedures.[8–11]

Simulators have been tested for catheter placement and manipulation, transseptal puncture, three-dimensional mapping and ablation system or for cardiac pacing, CRT, and left atrial appendage (LAA) closure, providing a significant improvement in manual skills and knowledge and reducing radiation exposure.[3,4,8–11,21–23] Improvement in fellows'

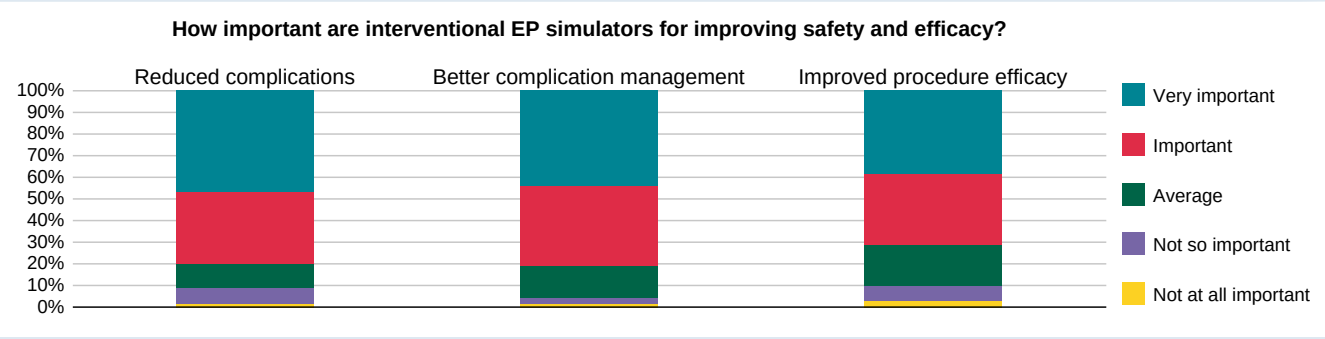


Figure 5 Impact of EP simulators on procedural safety and efficacy, according to respondents.

performance has been associated with a decreased amount of help from supervisors, decreased procedural steps times, and decreased fluoroscopy.[9]

Occupational radiation exposure is an important source of concern for choosing an EP carrier as recently described by the EHRA survey on occupational radiation exposure; therefore, an increase in the use of EP simulators would also represent an additional stimulus for young cardiologists to start an EP training[4] and a useful tool to reduce operator and patient exposure.

In addition, especially during COVID-19 pandemic when medical training has been severely affected, a virtual patient simulation training allowed medical students to continue their education path and to put into practice their clinical skills without the negative detrimental effects of a forced reduced patient interaction.[24]

Hands-on practice provided by simulators not only helps the initial skill learning of manual procedural steps of beginner trainees in a less stressful clinical scenario but also facilitates a faster introduction of new technologies and techniques for 'senior electrophysiologists'. For example, before LAA closure, it is a very useful tool to guide device sizing and choice according to different LAA anatomy obtained by pre-procedural imaging.[23]

Another field of application is teaching how to 'live' perform different EP manoeuvres for the differential diagnosis of arrhythmias (entrainment, parahisian pacing, and preceeding).

Simulator programmes are therefore perceived useful not only by electrophysiologist at the initial phase of their career but also by electrophysiologist in a more advanced stage, as reported in the present survey where half of the respondents were aged below 40 years old, but 47% were aged in the range 40–59 years, with a mean of 10 years of experience in EP.

However, these simulators are quite complex and expensive, and this may prevent their widespread integration in EP training programmes.

Currently, most of these virtual programmes are indeed offered by industries and are usually intended to address the introduction and development of new technologies. The role of industries for educational purposes may raise several issues regarding potential bias, inconsistency in training standards, high costs with limited availability, thus preventing a wide and equable participation in the programmes.

In order to spread accessibility to these training opportunities, almost all our respondents believe that simulators should be widely used and included in the institutional cardiology training programmes and should be supported or developed by EHRA.

The EHRA already plays an active role in EP education through virtual trainings such as periodic webinars, certification courses, and examinations. During the last EHRA Congress 2023, an official EHRA Simulation Village was available for all the EHRA participants who had the chance to test several standard and innovative EP simulators under the guidance of European EP experts. In addition, since many years, EHRA has provided the 'EHRA Training Fellowships programmes', which allow young fellows in EP to join high-quality hands-on training in recognized high-volume European Centres.[25–29] Nevertheless, a wider accessibility and a higher number of participating centres are probably needed in order to face the increasing complexity of EP procedures that have quickly evolved over the last years. In particular, our respondents indicate the major fields of focus as cardiac device implantation, such as CSP, CRT-D/P and leadless pacing, or complex arrhythmia ablations. The implementation of these procedures through EP simulator not only would improve the efficacy, but also could primarily enhance their safety, by reducing complications, and improving their management.

Limitations

The participation to this EHRA survey was voluntary, and therefore, the nature of the survey may have introduced a selection bias. Respondents with limited experience with simulation training may have primarily participated and perceive a higher need of these tools, resulting in their overestimation, as a consequence of expectation rather than practical experience. Therefore, caution should be made in generalizing the results of the present survey. However, it should be noted that a large exposure to EP simulators resulted among the respondents (at least 69%).

Another limitation may be represented by the sample size, which could not be representative of the whole EP community; nevertheless, there is a wide geographical distribution among different EHRA countries, stages of career, and ages of the respondents.

Conclusions

This EHRA survey pointed out the lack and necessity of providing simulation training programmes at a global European level in order to facilitate the access for the vast majority of EP doctors in training, to improve learning curve process and safety of EP procedures. The results of this survey may suggest a valuable input to enhance the current EHRA training fellowship programmes by ensuring a widespread integration of EP simulators.

Supplementary material

Supplementary material is available at *Europace* online.

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Data availability

The data underlying this article are available in the article and in its Supplementary material online.

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