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EHRA DOCUMENT

EHRA European Heart Rhythm Association

Arrhythmia care in ESC member countries: the 2025 ESC-EHRA atlas on heart rhythm disorders

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Abstract

The ESC-EHRA Atlas on Heart Rhythm Disorders was developed to comprehensively map arrhythmia care across the European Society of Cardiology (ESC) member countries. A survey of National Cardiac Societies, Working Groups, and other EHRA partners in ESC member countries was conducted to gather data from 2023 or the most recently available year on arrhythmia care organization and delivery. In total, 51 ESC member countries actively participated in the study, with a survey completeness rate of 91%. The median number of hospitals performing EP or CIED procedures was 3.3 per million people. The annual median numbers of ablation procedures for heart rhythm disorders, atrial fibrillation, and supraventricular tachycardia per million people were 432, 151, and 136, respectively. The annual median numbers of pacemakers, implantable cardioverter-defibrillators (ICD), and cardiac resynchronization therapy cardioverter-defibrillator (CRT-D) implantations per million people were 739, 195, and 54, respectively. The median number of hospitals performing remote monitoring of CIEDs per million people was 0.5, though this service was unavailable in 15 countries. Two main universal issues emerged among the obstacles to guideline implementation: a lack of heart rhythm allied professionals and general dissatisfaction with the country's reimbursement system. The first edition of the ESC-EHRA Atlas presents up-to-date information on arrhythmia care organization and delivery among ESC member countries and highlights significant discrepancies in patients' access to ESC-guideline-recommended therapies.

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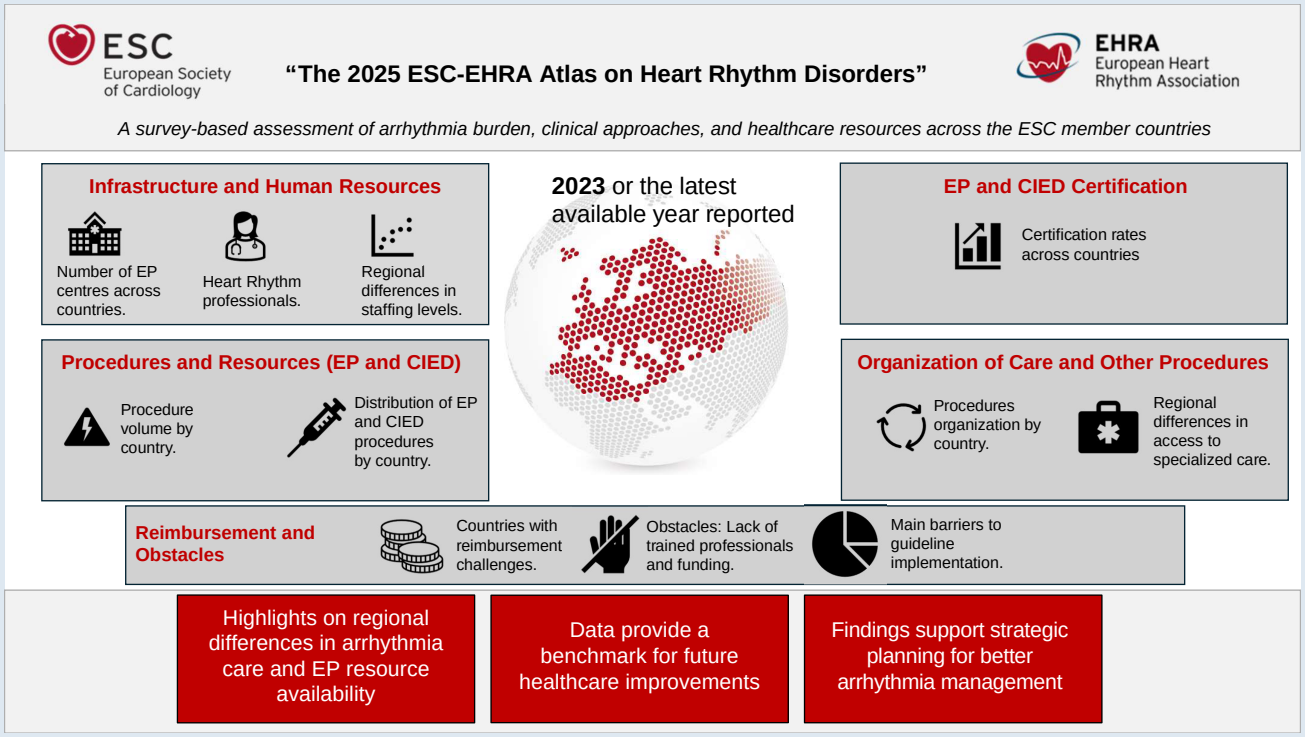
Graphical Abstract



Keywords Arrhythmia • Ablation • European Society of Cardiology • Cardiac pacemakers • Health infrastructure • Health economics • Implantable cardiac defibrillators • Statistics • Reimbursement

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Introduction

Cardiac arrhythmias represent a major public health challenge across Europe, contributing significantly to morbidity, mortality, and healthcare costs.[1-8] Despite advancements in diagnosis and treatment, substantial variations exist in arrhythmia prevalence, treatment patterns, and healthcare capabilities among the European Society of Cardiology (ESC) member countries.[9-11] These disparities are influenced by factors, such as healthcare infrastructure, access to specialized care, guidelines adherence, and the availability of advanced therapeutic modalities, including catheter ablation, device therapy, and pharmacological interventions.[12-22] The ESC-EHRA Atlas on Heart Rhythm Disorders, a project run under the ESC Atlas framework, aspires to systematically monitor and map existing realities.

Primarily, this survey aims to gain a deeper understanding of the current landscape and to systematically assess the burden of arrhythmias, the clinical approaches to their management, and the healthcare resources available across ESC member countries. The findings will offer critical insights into regional differences in patient care, identify gaps in service provision, and support the development of targeted strategies to improve arrhythmia management in Europe. By gathering data from diverse healthcare systems, this initiative will help inform policy decisions, optimize resource allocation, and contribute to more equitable and effective arrhythmia care across ESC member countries. The results will also serve as a benchmark for future improvements in clinical practice and healthcare delivery in the field of cardiac electrophysiology.

Methods

Data sources

The statistics presented in this manuscript are the result of the ESC-EHRA survey based on the ESC Atlas data framework.[23] Data were derived from a survey of National Cardiac Societies, Working Groups and other EHRA partners in ESC member countries. Additionally, a number of data points were obtained from the database of the latest edition of ESC Cardiovascular Statistics or from the official EHRA website.[23,24] World Bank population census data were used for calculating rates per million population. All original data sources were recorded for traceability.[23] The survey provides absolute numbers for resources and procedures, while crude rates per million population are calculated using population estimates from the World Bank.[23] In general, as in the main Atlas project, population data were derived from official sources (World Bank, Organization for Economic Cooperation and Development, OECD) to ensure consistency and accuracy in rate calculations.[23]

Data collection

The data collection encompassed 98 variables related to human and capital infrastructure, as well as major cardiovascular (CV) interventions and services, across ESC member countries. These variables, developed by a dedicated task force, were included in a structured questionnaire distributed to the EP National Cardiac Societies, Working Groups and other EHRA partners. Definitions of variables are available in the Supplementary material online. The task force prioritized variables that reflect essential aspects of clinical care, infrastructure, and health outcomes, aligning them with public health priorities. The selection process ensured the variables' relevance and applicability. The survey is composed of two main sections: Numerical and categorical. The numerical section collects quantitative data where respondents provide specific values, such as the number of procedures performed or resources available. The categorical section focuses on qualitative data, capturing information about the availability and accessibility of services and products, as well as reimbursement policies. Data sources were categorized as follows: official government websites and reports, industry sources, local publications, national registries, estimations, and personal communications. Data completeness per country is listed in the Supplementary material online. Missing data were not imputed but are explicitly marked in the figures and Supplementary material online to maintain transparency.

Quality control

Quality control procedures were applied to the data to identify outliers and illogical values.[23] As part of this process, total variables were systematically reviewed alongside their corresponding subtotal variables. The data were validated against predefined definitions, ensuring they accurately represented their intended components. The quality control process also included comparisons of the current dataset with publicly available data. Discrepancies were flagged for further investigation with the respective national contributors. Flagged values were then reviewed with the respective national contributing entities and corrected as necessary. The EP National Cardiac Societies, Working Groups and other EHRA partners were an integral part of this process, leveraging their expertise and local insights. Modifications were applied only after thorough verification to ensure all adjustments aligned with the original data structure and definitions.

This approach ensured the logical integrity of the dataset and facilitated consistency across variables, enhancing the reliability of the findings presented in this article.

Data presentation

The data are presented descriptively for ESC member countries, accompanied by illustrative tables and charts from the ESC-EHRA Atlas on Heart Rhythm Disorders survey. Data representing the year 2023 or the most recently available year is included in this project. For consistency and comparability, country-level data are calculated as a rate per one million inhabitants. The categorical data have been reported as percentages. Summary statistics are reported as medians and interquartile ranges (IQR) to minimize the influence of outliers and provide a more accurate representation of data distribution across diverse countries. Countries with missing data are listed both in a footnote of a figure and in the Supplementary material online. Values reported as '0' are presented in the footnotes to the figures and taken into consideration when calculating medians (IQR).

Results

Data for 2023, or the most recently available year, were collected via a questionnaire from 51 countries: Algeria, Armenia, Austria, Azerbaijan, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Egypt, Estonia, Finland, France, Georgia, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Kazakhstan, Republic of Kosovo, Kyrgyzstan, Latvia, Lebanon, Lithuania, Luxembourg, Malta, Republic of Moldova, Montenegro, Netherlands, North Macedonia, Norway, Poland, Portugal, Romania, Republic of San Marino, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Tunisia, Türkiye, Ukraine, UK, and Uzbekistan. Data completeness rate was high—91% with median per-country completeness rate 95.3% (IQR 86.7–99.2%). The country-specific datasets are available in the Supplementary material online.

Infrastructure

A median of 3.3 (IQR 1.8–5.1) hospitals per million people undertook electrophysiology (EP) or device implantation procedures for diagnostic or interventional purposes in adults (*Figure 1*); the following countries reported one hospital: Malta, Montenegro, and Republic of San Marino. EP or cardiac implantable electronic device (CIED) procedures in children were performed in a median of 0.3 (IQR 0.2–0.6) hospitals per million people: six countries reported 0 and 12 countries reported one hospital. A median of 1.3 (IQR 0.8–1.7) hospitals per million people had on-site cardiac surgery.

A median of 1.2 (IQR 0.8–1.9) hospitals per million people performed atrial fibrillation (AF) ablation ranging from 0 in Republic of Kosovo and Republic of San Marino to >4 in Cyprus and Germany while a median of 1 (IQR 0.5–1.5) hospital per million people performed ventricular tachycardia (VT) ablation in patients with structural heart disease (SHD) ranging from 0 in Republic of Kosovo, North Macedonia and Republic of San Marino to >2.4 in Germany, Iceland and Switzerland. A median of 3.1 (IQR 1.8–5) hospitals per million people performed pacemaker implantations. Conduction system pacing (CSP) devices were implanted in a median of 0.9 (IQR 0.5–1.6) hospitals per million people, ranging from 0 in six countries to >3 in Finland, Luxembourg and Switzerland. Implantable cardioverter-defibrillators (ICDs) and/or cardiac resynchronization therapy (CRT) devices were implanted in a median of 2.3 (IQR 1.5–3.6) hospitals per million people, ranging from 0 in Republic of San Marino to >7 in Cyprus, Germany, Italy, Spain and Switzerland. Transvenous lead extraction (TLE) was performed in a median of 0.6 (IQR 0.2–0.9) hospitals per million people: ranging from 0 in seven countries to >1.4 in Estonia and Cyprus, Luxembourg and Malta.

Human resources

Country-specific number of operators in EP, CIED, and TLE per million people are provided in *Figure 2*. For paediatric electrophysiologists, there were only 0.4 (IQR 0.1–0.7) per million people ranging from 0 in nine countries to >2 in Estonia, Lithuania, and Slovenia. Across all ESC member countries, EP operators were predominantly male: female EP operators accounted for a median of 13% (IQR 6–22; range: 0% in eight countries to over 30% in Armenia, Latvia, and Tunisia), while female CIED operators accounted for a median of 14% (IQR 8–20; range: 0% in four countries to over 30% in Algeria, Romania, and Tunisia).

Country-specific number of fellows in EP, CIED, and TLE are shown in *Figure 3*. Heart rhythm allied professionals numbered 3.5 (IQR 0.5–13) per million people (range 0 in seven countries to >40 in Norway

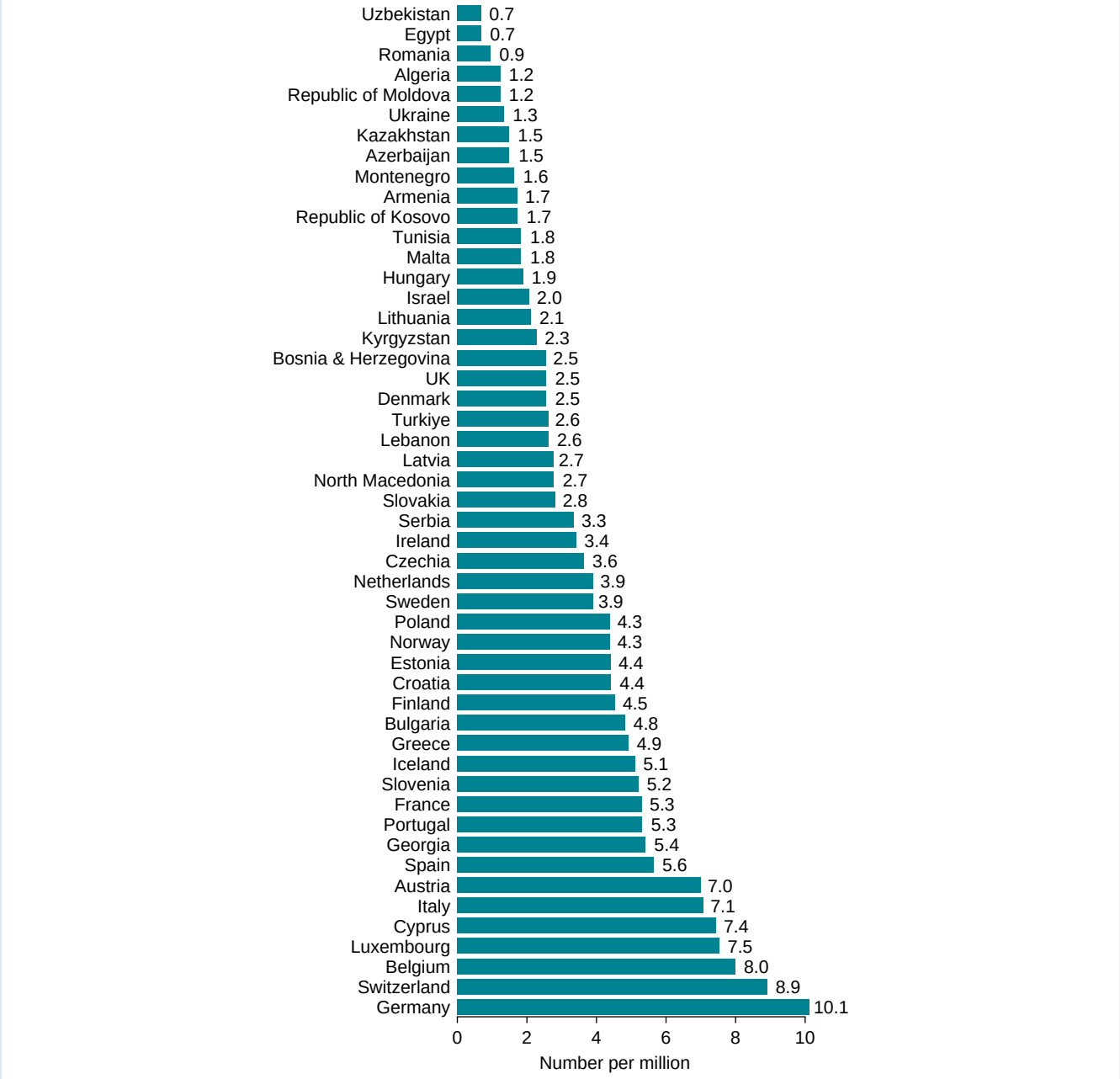

Figure 1 The number of hospitals per million people in each country that perform electrophysiology procedures for diagnostic or interventional purposes or implant cardiac electronic devices. Malta, Montenegro, and Republic of San Marino reported only one hospital.

and Poland) falling to 1.6 (IQR 0–7.2) per million people (range: 0 in 10 countries to >25 in Denmark and Poland) if only dedicated allied professionals working full-time or certified in EP or CIED were considered.

Electrophysiology and cardiac implantable electronic device certification

Over the past few decades, to ensure the quality of patient care, many ESC member countries have progressively implemented certification requirements for EP or CIED specialists, allied professionals, and hospitals. An analysis of the collected data reveals that approximately 45% of ESC member countries have a formal certification process for physicians performing EP or CIED implantations. Certification is typically provided by national cardiac societies, working groups, or other entities such as universities. In eleven countries—22% of the total—certification for performing EP or CIED procedures is mandatory, primarily for reimbursement purposes. Additionally, in 12 countries—24% of the respondents in our survey—there is a formal hospital certification process overseen by an official government body to ensure the quality of care provided and to facilitate reimbursement for the procedures performed.

The EHRA EP or CIED certification is recognized to varying degrees across ESC member countries that participated in the survey. Overall, EHRA EP and CIED certification is acknowledged in 92% of these

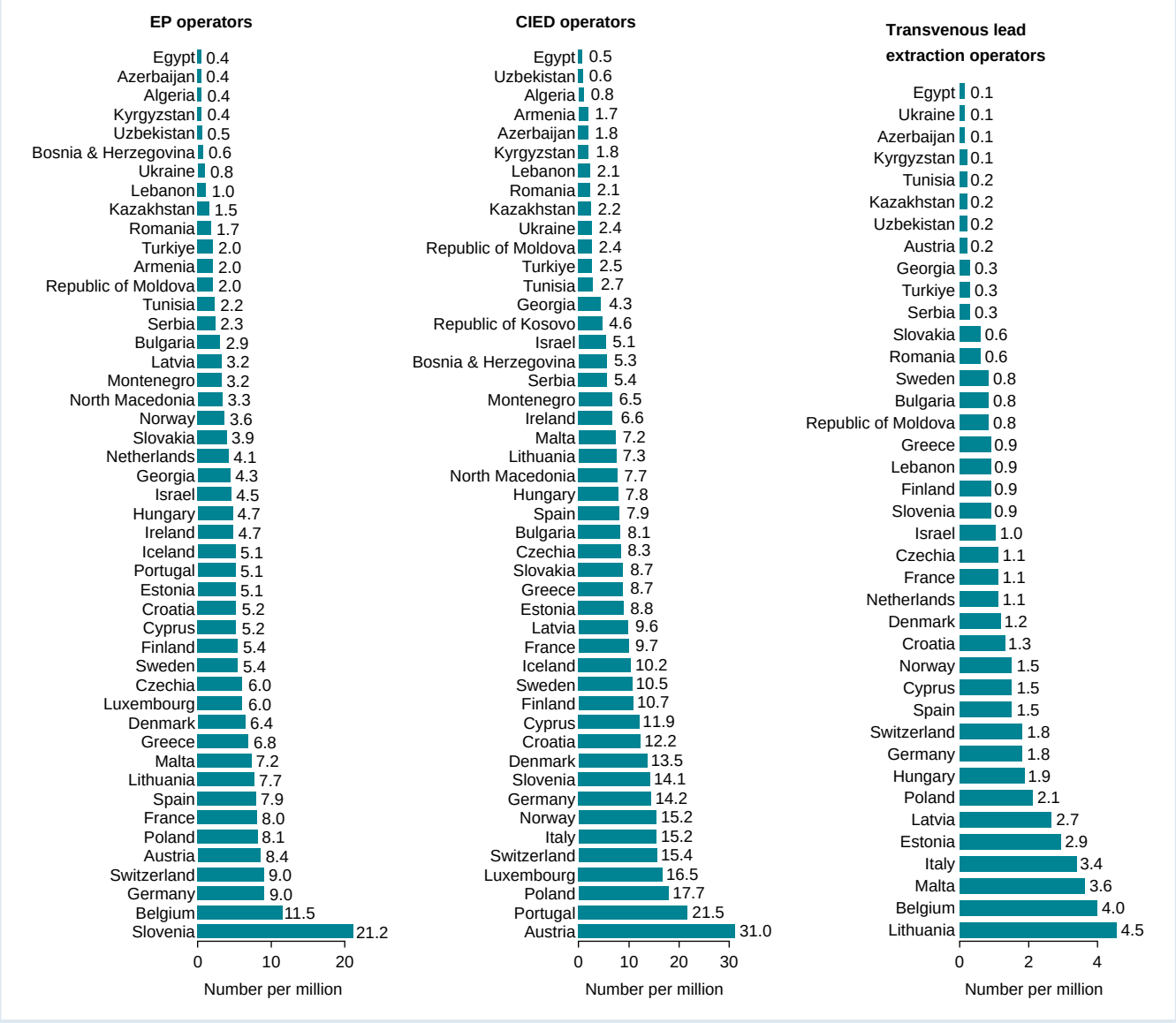

Figure 2 Number of operators in electrophysiology, cardiac implantable electronic devices, and transvenous lead extraction, per million people by country. EP operators. Republic of Kosovo reported 0 while Republic of San Marino reported only one EP operator. Missing data: Italy, UK. CIED operators. Missing data: Belgium, Netherlands, UK. Republic of San Marino reported 0 CIED operators. Transvenous lead extraction operators. Algeria, Armenia, Bosnia and Herzegovina, Iceland, Republic of Kosovo, North Macedonia, Montenegro, and Republic of San Marino reported 0 TLE operators. Missing data: Algeria, Ireland, Luxembourg, Portugal, UK.

countries. In 12 countries—26%—it holds equal value to nationally provided certification. However, in more than half of the surveyed countries, this certification carries only informal recognition. In five countries—Croatia, Malta, the Netherlands, Sweden, and Switzerland—the EHRA certification is recognized as the only available personal certification.

Procedures and resources in electrophysiology

A median of 1.5 (IQR 0.9–2.4) hospitals per million people performed any EP procedures, ranging from <0.5 in Algeria, Azerbaijan, Egypt, and Ukraine, to >4 in Cyprus, Germany, and Italy. Country-specific numbers of hospitals undertaking ≥100 ablation procedures and ≥50 AF ablations per million people are shown in *Figure 4*. Cryoballoon, radiofrequency, and pulsed field ablation technologies were used in a median of 0.9, 1.1, and 0.2 hospitals per million people, respectively. Epicardial VT ablation was performed in only 0.3 hospitals per million people, and zero fluoroscopy ablation in 0.2 hospitals per million people.

The annual median number of ablation procedures for heart rhythm disorders was 432 (IQR 131–648) and ranged from <20 per million people in Algeria to >1300 in Belgium and France (*Figure 5*); Republic of San Marino reported 0 ablations in 2023. The annual median number of AF ablations was 151 (IQR 31–286) and ranged from 0 procedures in Republic of Kosovo and Republic of San Marino to >600 in Switzerland, Denmark and Germany (*Figure 5*). Radiofrequency ablation (RFA) was the dominant modality in Belgium, cryoballoon ablation (CB) in Germany, and pulsed field ablation (PFA) in Czechia.

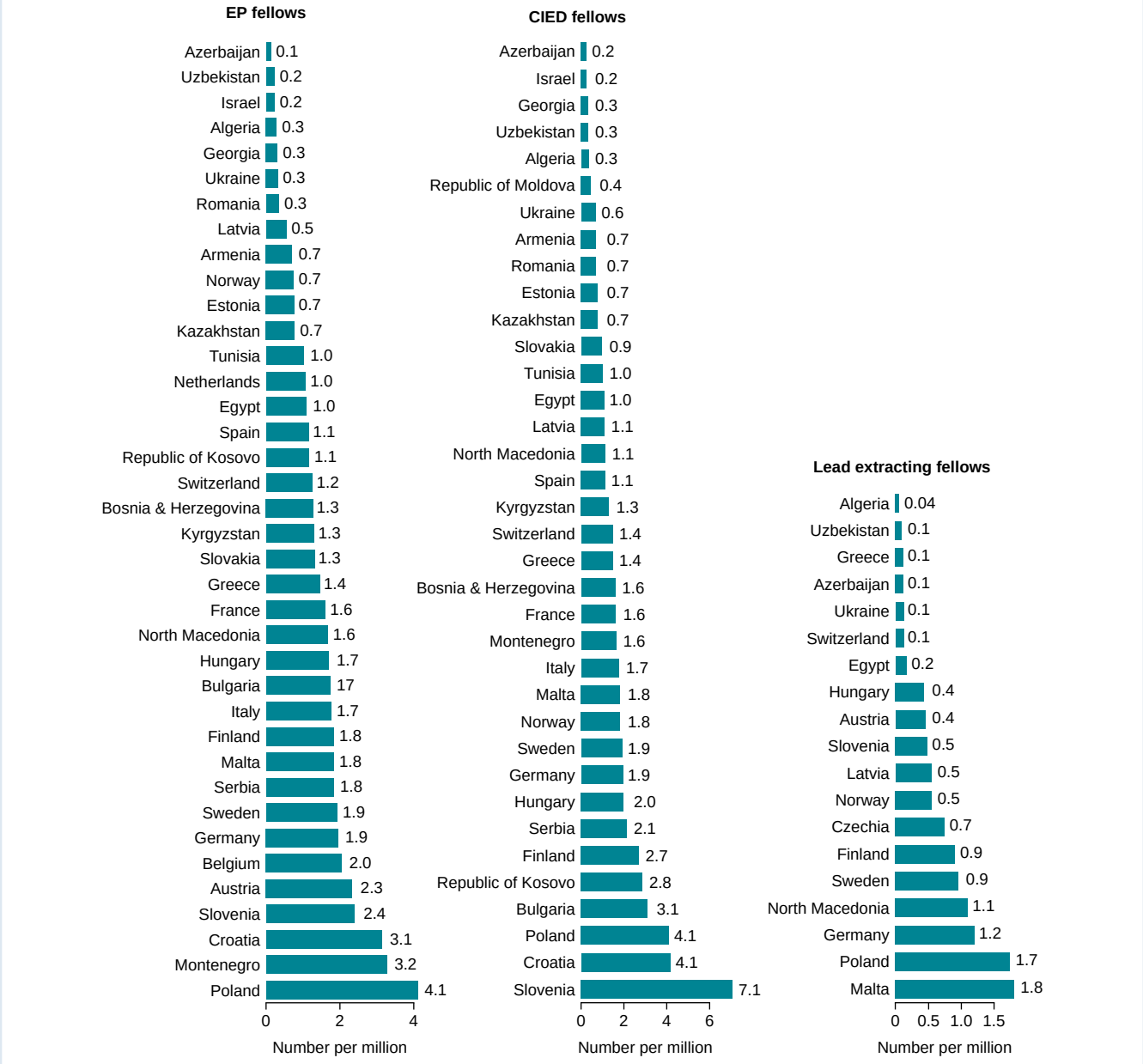

Figure 3 Numbers of fellows in electrophysiology, cardiac implantable electronic devices, and transvenous lead extraction per million people by country. EP fellows. Cyprus, Iceland, Lebanon, Lithuania, Luxembourg, Republic of Moldova, and Türkiye reported 0 EP fellows. Missing data: Czechia, Denmark, Ireland, Portugal, Republic of San Marino, UK. CIED fellows. Cyprus, Iceland, Lebanon, Lithuania, Luxembourg, and Republic of San Marino, and Türkiye reported 0 CIED fellows. Missing data: Austria, Belgium, Czechia, Denmark, Ireland, Netherlands, Portugal, UK. Lead extracting fellows. Armenia, Bosnia and Herzegovina, Cyprus, Estonia, Georgia, Iceland, Israel, Republic of Kosovo, Kyrgyzstan, Lebanon, Lithuania, Luxembourg, Republic of Moldova, Montenegro, Romania, Republic of San Marino, Serbia, Slovakia, and Türkiye reported 0 TLE fellows. Missing data: Belgium, Bulgaria, Croatia, Denmark, France, Ireland, Italy, Kazakhstan, Netherlands, Portugal, Spain, Tunisia, and UK.

Numbers of supraventricular tachycardia (SVT) ablations per million people ranged from <10 in Algeria to >300 in France, Germany, and Switzerland, premature ventricular contractions/idiopathic VT ablations from <0.6 in Algeria, Bosnia and Herzegovina and Republic of Kosovo to >90 in Greece and Poland and ablations for VT in SHD from 0 in four countries to >40 per million people in Czechia, France, and Switzerland. Numbers of paediatric ablations ranged from 0 in five countries to >20 per million people in Estonia, Iceland, and Norway, congenital heart disease ablations from 0 in eight countries to >15 per million people in Germany and Switzerland and cardioneuroablation from 0 in 23 countries to >6 in Belgium and Czechia.

Procedures and resources in cardiac implantable electronic device

The median number of pacemaker (PM) implantations (first-time and replacement), was 739 (IQR 264–953) per million people, ranging

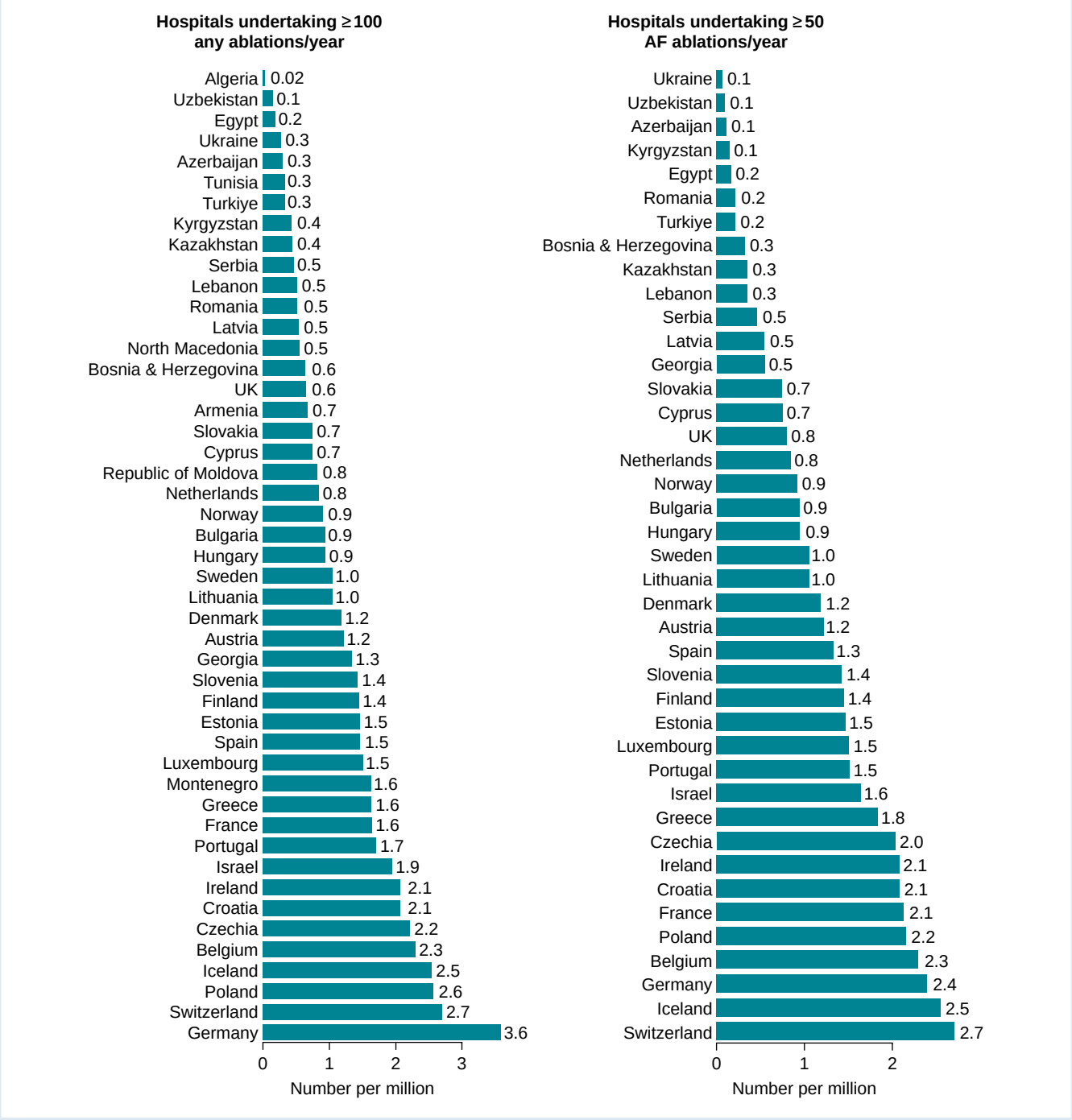

Figure 4 Number of hospitals by country performing 100 or more of any ablations for heart rhythm disorders per million people and those performing 50 or more of AF ablations per million people. Hospital undertaking ≥100 any ablations per year. Republic of Kosovo, Malta, Republic of San Marino reported 0 while Algeria, Cyprus, Iceland, Latvia, Luxembourg, Montenegro, and North Macedonia reported only one hospital. Missing data: Italy. Hospital undertaking ≥50 AF ablations/year. Algeria, Armenia, Republic of Kosovo, North Macedonia, Malta, Republic of Moldova, Montenegro, Republic of San Marino reported 0 while Azerbaijan, Bosnia & Herzegovina, Cyprus, Iceland, Kyrgyzstan, Latvia, and Luxembourg reported only one hospital. Missing data: Italy, Tunisia.

from <50 in Azerbaijan, Kyrgyzstan, and Uzbekistan to >1000 in 11 countries (*Figure 6*). The median number of leadless PM (LPM) implantations was 2.5 (IQR 0–9) per million people ranging from 0 in 13 countries to >30 in France, Israel, and Switzerland (*Figure 7*). The median number of CSP implantations was 7.8 (IQR 0.9–34.5) per million people ranging from 0 in nine countries to >100 in Czechia, Estonia, France, and Switzerland. The median number of cardiac resynchronization therapy pacemakers (CRT-P) implantations was 25.3 (IQR 6.3–56.6) per million people, ranging from <0.3 in Azerbaijan, Georgia, and Kazakhstan to >90 in Bulgaria and UK.

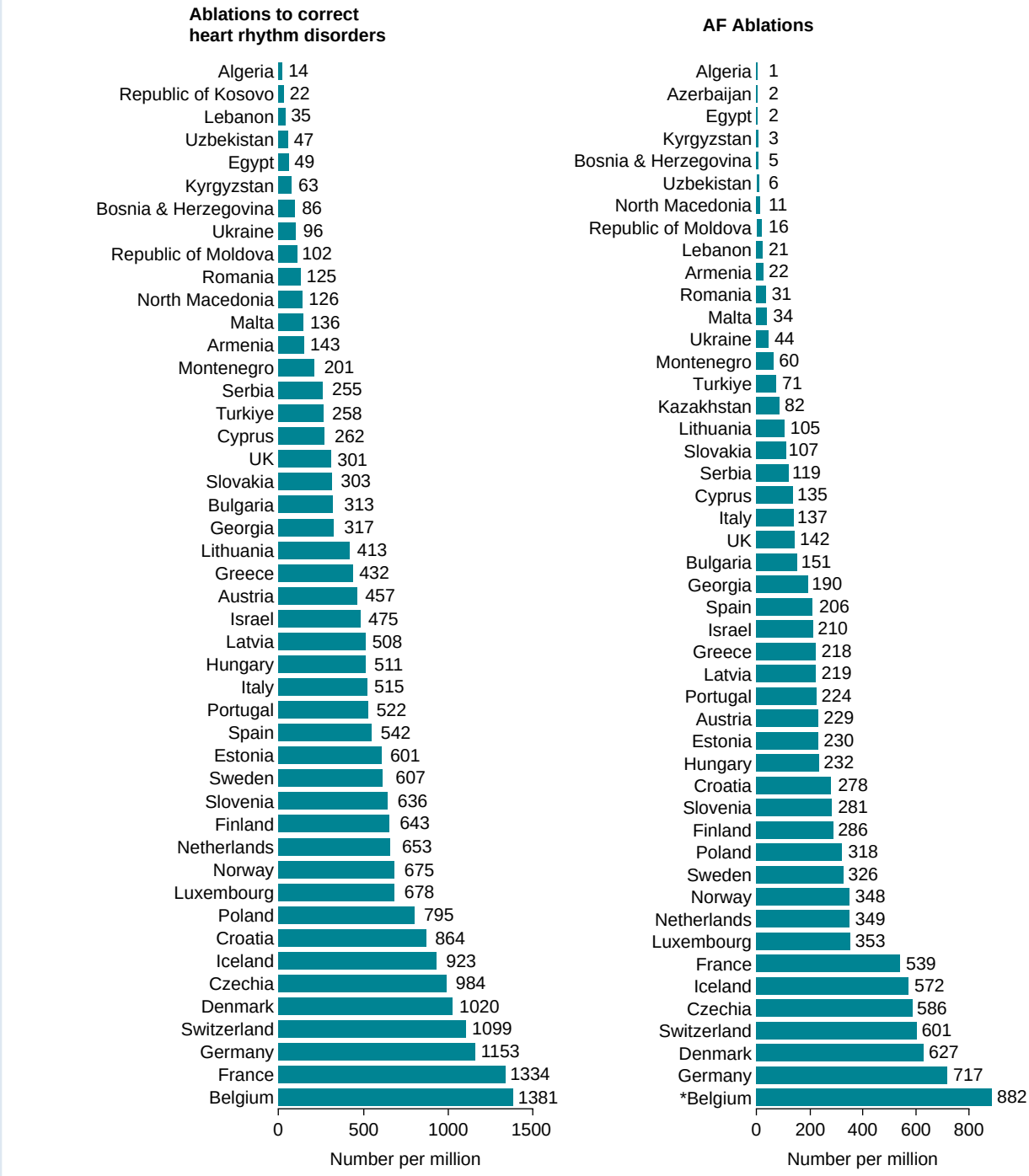

Figure 5 Number of ablation procedures for heart rhythm disorders per million people by country (*A*), number of AF ablations per million people by country (*B*). Ablations to correct heart rhythm disorders. Republic of San Marino reported 0 ablations. Missing data: Azerbaijan, Ireland, Kazakhstan, Tunisia. AF Ablations. Republic of Kosovo and Republic of San Marino reported 0 AF ablations. Missing data: Ireland, Tunisia. * Belgium reported AF and other complex left atrial ablations together, in accordance with national rules on procedure reporting for reimbursement.

The median numbers of conventional ICD and subcutaneous/extravascular ICD implantations per million people was: 125 (IQR 35–160) and 1.8 (IQR 0–6.2), respectively; country-specific numbers are presented in *Figure 8*. The median number of cardiac resynchronization therapy cardioverter-defibrillators (CRT-D) implantations per million people was 54 (IQR 19–83) ranging from <2 in Bosnia and Herzegovina and Uzbekistan to >130 in Czechia, Italy, and Poland.

The median number of TLE procedures per million people was 8.2 (IQR 2–17.7) ranging from 0 in six countries to >30 in France, Germany, Poland, and Slovenia. Median numbers of TLEs due to

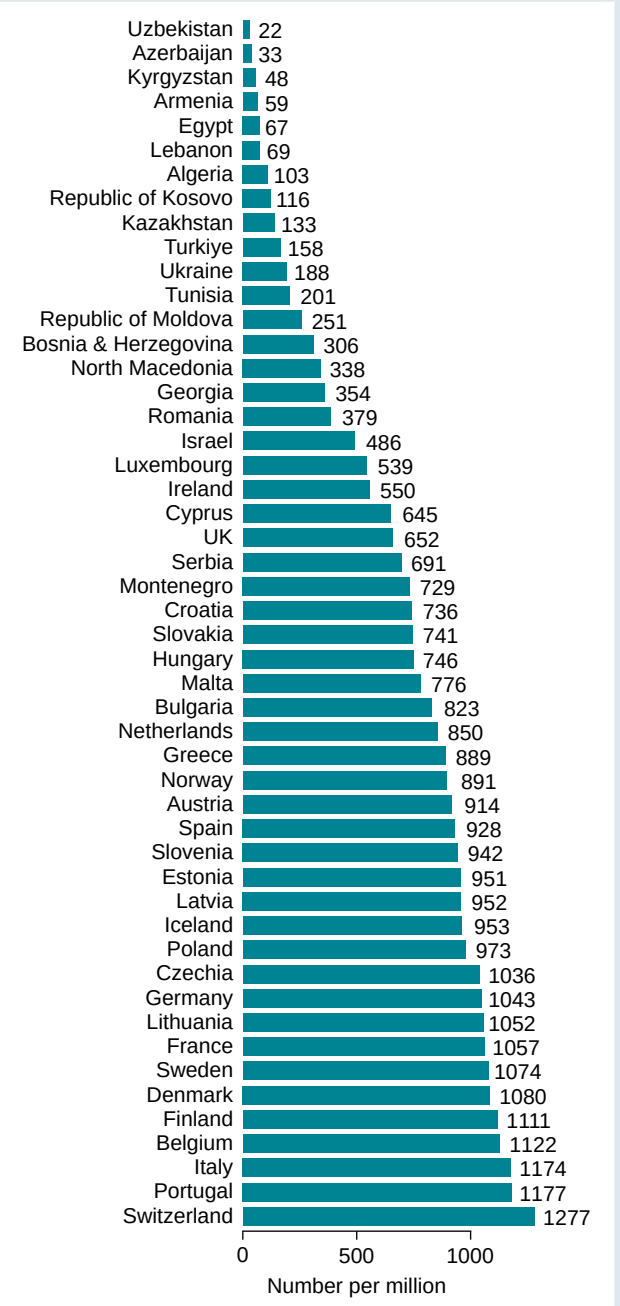

Figure 6 Number of pacemaker implantations regardless of type or indication. Missing data: Republic of San Marino.

infective or non-infective indications per million people were: 4 (IQR 0.8–8.2) and 2.2 (IQR 0.02–8.4), respectively.

The median number of hospitals implanting loop recorders (ILR) per million people was 1.9 (IQR 0.5–3.8) ranging from 0 in four countries to >7 in Austria, Cyprus and Germany. The median number of ILR implantations per one million people was 24.6 (IQR 2.5–92.5) ranged from 0 in four countries to >200 in Austria, France, and Switzerland.

Organization of care and other procedures

Patient access to CIED remote monitoring varied widely (*Figure 9*). The median number of hospitals performing remote monitoring of CIEDs per one million people was 0.5 (IQR 0–1.9) ranging from 0 in 17 countries up to 17.9 in Germany. In paediatric populations, the median number of hospitals offering CIED remote monitoring per million people was 0 (IQR 0–0.2) and ranged from 0 in 21 countries to >4 in Sweden.

Of the 50 countries that reported availability of genetic testing only 26 had developed structured national programmes for inherited arrhythmia syndromes with the Netherlands providing genetic testing at all academic centres while in most other countries it was limited to large centres.

Some form of national community training in basic or advanced life support was reported in 43 countries (*Figure 10*) with public access to cardioverter-defibrillators mandated by law in 18 countries. In the remaining 32 countries automated external defibrillators were often available despite the absence of official regulation.

There was little provision for wearable cardioverter-defibrillators (WCD) among ESC member countries with 34 countries reporting 0 patients in 2023 and only Austria, France, and Germany reported medians of >70 patients per million people.

The median number of hospitals performing left atrial appendage closure (LAAC) per million people with an electrophysiologist directly involved in the procedure was 0.3 (IQR 0–0.9) ranging from 0 in 13 countries to >2 in Estonia, Belgium, Italy and >5 in Germany. The median number of such procedures was 3.1 (IQR 0–13.3) per million people ranging from 0 in 13 countries to >50 in Belgium, Denmark, and Germany.

Only five countries reported availability of a formal structured network for optimized management of VT or electrical storm. However, some countries are negotiating with the authorities or awaiting a final decision for the establishment of such a network while others have developed informal arrangements with specialist centres for referral of patients with VT, e.g. Denmark and Czechia.

Reimbursement and obstacles to clinical practice or guideline implementation

Table 1 summarizes procedure-based reimbursement statistics for ESC member countries. Those procedures that were nationally available were mostly covered by mandatory public insurance sometimes supplemented by cash payment. New technologies were adopted at different rates across ESC member countries and while conventional ICDs, for example, were available in all countries, leadless devices were unavailable in seven countries and remote follow-up of high-energy devices in nine countries reporting to the Atlas. Dedicated reimbursement for paediatric EP or CIED procedures was provided by 22 countries, for magnetic resonance imaging in patients with CIEDs by 10 countries and for CSP pacemaker implantations in 11 countries.

Obstacles to clinical practice or guideline implementation are summarized in *Table 2*. General satisfaction or a neutral attitude towards the local reimbursement system was reported by 30 countries despite negativity about tariff levels in countries such as Spain, Germany, and Italy, otherwise reporting high EP/CIED procedure rates. Although 36 countries considered the numbers of patient referrals for EP/CIED procedures satisfactory, concern was often expressed about regional inequalities in procedure rates within national borders. Operator availability showed considerable heterogeneity across ESC member countries (*Figure 11*) with Poland, France, and Croatia, for example, reporting sufficient CIED and EP operators while Romania, Czechia, and Uzbekistan reported a shortage, particularly affecting CIED operators. A shortage of allied professionals was reported by 40 countries, a lack of guideline awareness by 9 countries and a lack of access to relevant technology by 17 countries.

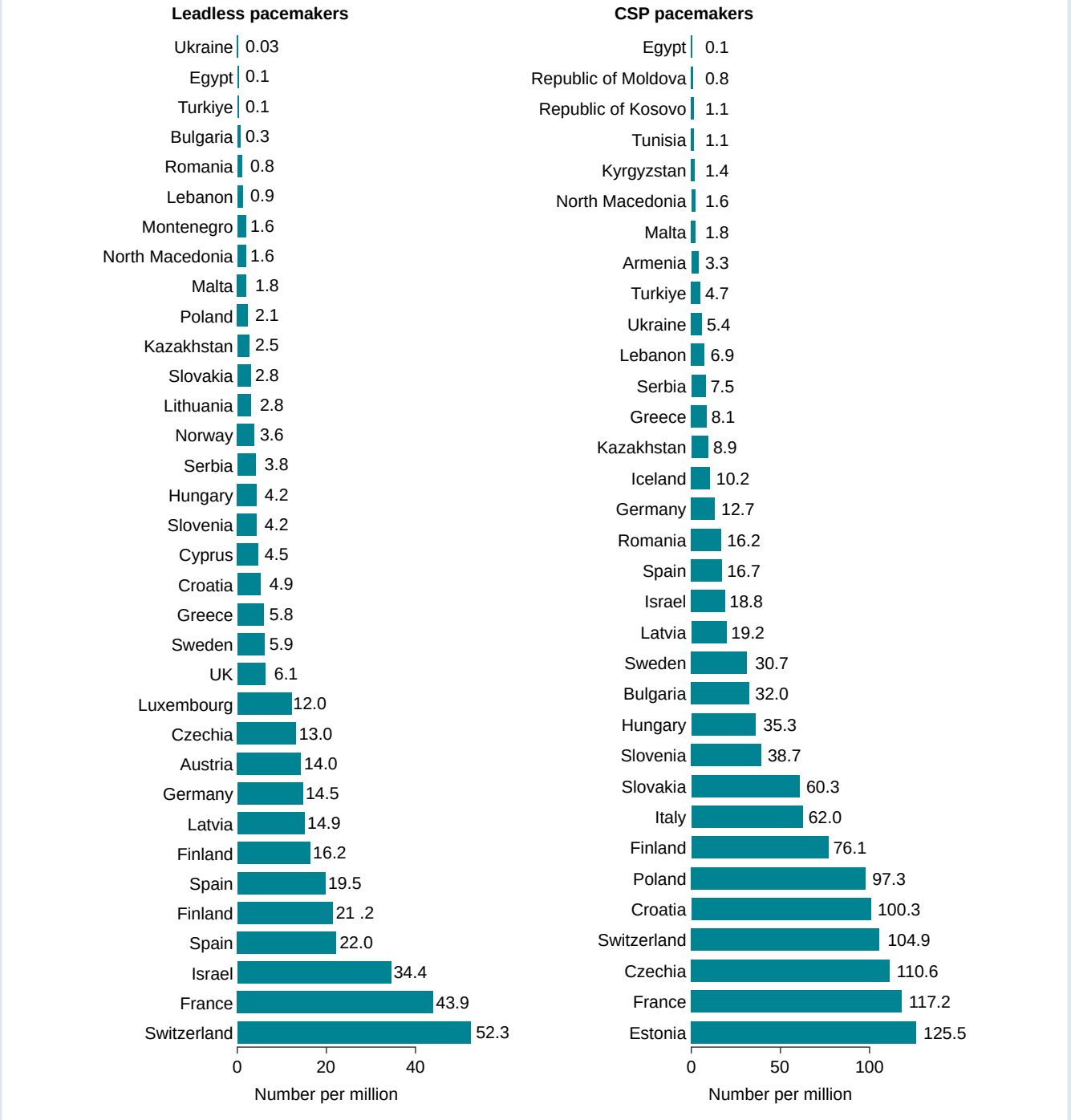

Figure 7 Number of leadless pacemaker implantations per million people by country (*A*), and number of conduction system pacing stimulator implantations per million people by country (*B*). Leadless pacemakers. Algeria, Armenia, Azerbaijan, Bosnia and Herzegovina, Estonia, Georgia, Iceland, Republic of Kosovo, Kyrgyzstan, Republic of Moldova, Portugal, Tunisia, and Uzbekistan reported 0 leadless pacemaker implantations. Missing data: Belgium, Ireland, Netherlands, Republic of San Marino. CSP Pacemakers. Reported value zero: Algeria, Azerbaijan, Bosnia and Herzegovina, Cyprus, Georgia, Lithuania, Montenegro, and Uzbekistan reported 0 CSP pacemaker implantations. Missing data: Luxembourg, Austria, Belgium, Denmark, Ireland, Netherlands, Norway, Portugal, Republic of San Marino, UK.

Discussion

The ESC Atlas on Heart Rhythm Disorders presents a comprehensive and up-to-date analysis of ESC member countries' resources and procedures for diagnosing and treating arrhythmias. Data showed substantial international heterogeneity with procedure rates per million people often varying by a factor of 100 or more. Generally speaking, the more complex or demanding the procedure the less was its availability, particularly in the case of newer technologies (e.g. CSP pacemakers) or paediatric indications. Regarding operators, CIED specialists were the

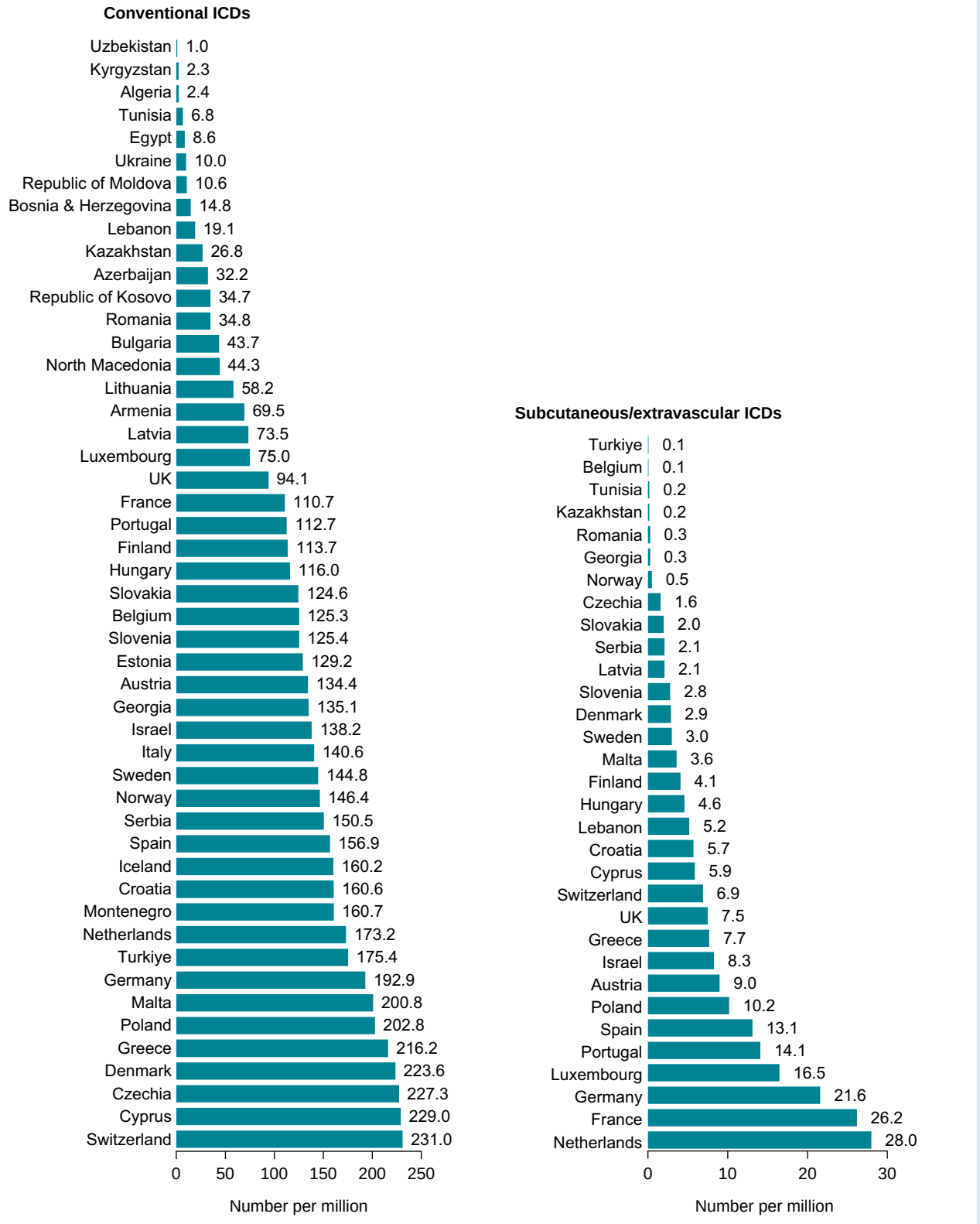

Figure 8 Number of conventional implantable cardioverter-defibrillators implanted per million people by country (*A*), and the number of subcutaneous/extravascular cardioverter-defibrillators implanted per million people by country (*B*). Conventional ICDs. Missing data: Ireland, Republic of San Marino. Subcutaneous/extravascular ICDs. Algeria, Armenia, Azerbaijan, Bosnia and Herzegovina, Bulgaria, Egypt, Estonia, Iceland, Republic of Kosovo, Kyrgyzstan, Lithuania, North Macedonia, Republic of Moldova, Montenegro, Ukraine, and Uzbekistan reported 0 implantations of subcutaneous/extravascular ICDs. Missing data: Ireland, Italy, Republic of San Marino.

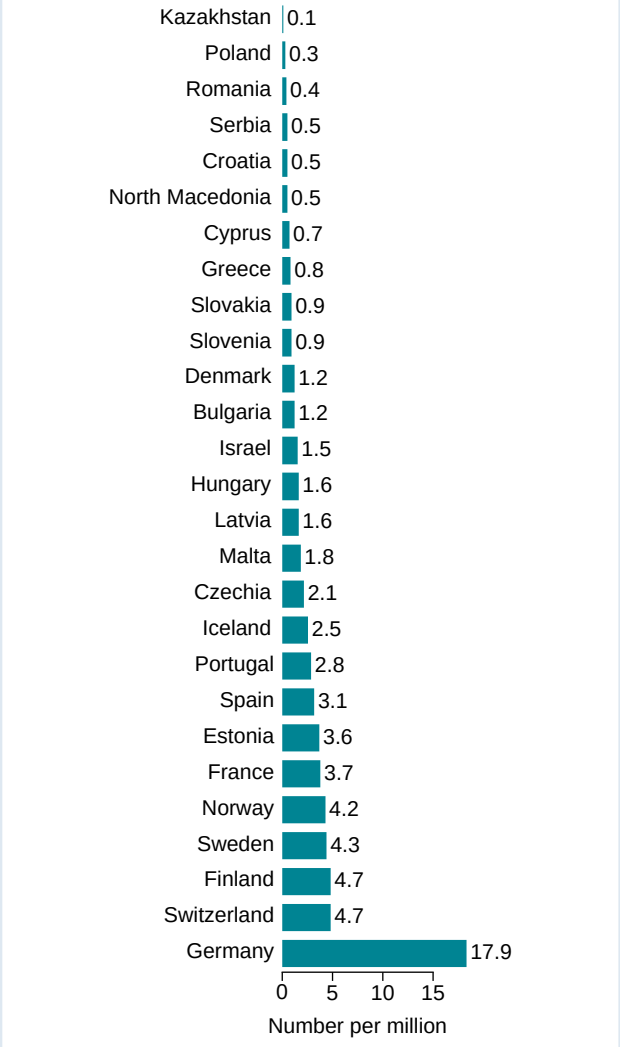

Figure 9 Number of hospitals per one million people that perform remote monitoring of cardiac implantable electronic devices. Algeria, Armenia, Azerbaijan, Bosnia and Herzegovina, Egypt, Georgia, Republic of Kosovo, Kyrgyzstan, Lebanon, Lithuania, Luxembourg, Montenegro, Republic of Moldova, Tunisia, Türkiye, Ukraine, Uzbekistan reported 0 while Cyprus, Iceland, Malta, North Macedonia reported only one hospital. Missing data: Austria, Belgium, Ireland, Italy, Netherlands, Republic of San Marino, UK.

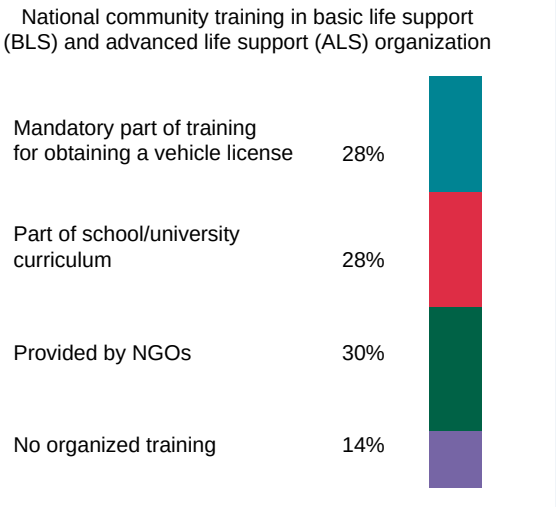

Figure 10 Types of national community training programmes in basic or advanced life support. All survey participants replied.

most prevalent, followed by EP operators, with TLE operators considerably less numerous. Female operators constituted a minority. A nearly universal issue was the lack of allied heart rhythm professionals. Approximately half of the countries had some form of certification process to confirm EP or CIED expertise, while in about 80% of countries EHRA certification was recognized formally or had an informal value.

The number of EP and CIED procedures was generally highest in the high-income countries of western and northern Europe although procedure rates were comparable in Bulgaria, Czechia, Croatia, and Poland. The adoption of new CIED technologies such as LPM or subcutaneous/extravascular ICD was uneven, and several countries reported no implants in 2023 or the latest available year. The same was true for CIED remote monitoring and WCD.

The ESC-EHRA Atlas recorded organizational statistics such as genetic testing for inherited arrhythmia syndromes, BLS/ALS training for sudden cardiac death and access to public cardioverter-defibrillators. Results were encouraging with high implementation of these important public health measures.

Among obstacles to guideline implementation, a lack of heart rhythm allied professionals and complaints about local reimbursement systems received special attention. Both were consistently reported by countries with high procedure rates. In one-third of countries, it was limited access to technology for use in clinical practice rather than a lack of reimbursement that was identified as the principal problem. Particularly newer CIED technologies, including remote monitoring, influenced this situation.[13,25,26]

The reimbursement system can significantly influence country-specific healthcare delivery and access to new technologies.[12,13,22] A detailed description of the reimbursement systems of all ESC member countries was beyond the scope of this project. However, a simplified method of mapping public or private coverage of arrhythmia was undertaken. The majority of procedures were fully reimbursed by national healthcare services or social insurance systems; however, procedural tariffs may have been lower than expected by respondents. This was probably, at least in part, due to a Diagnosis-Related Group (DRG) system adopted in many European countries.[12] Only in a minority of situations was the patient required to pay for the procedure personally.

The authors of this manuscript deliberately avoided elaborate data analyses or deeper comparisons. Instead, they focused on presenting comprehensive information in the manuscript itself or in the Supplementary, where all country-specific data can be found. Therefore, there are no comparisons between high-income and low-income countries or in-depth analyses of the interaction between the number of procedures and reimbursement seen in other Atlas publications.

The ESC-EHRA Atlas data cannot be compared with the 2017 EHRA White Book, not only because of the time gap between the two projects, but also because the methodology and presentation of results are different.[14] More comparable is the 2023 Asia Pacific Heart Rhythm Society (APHRS) White Book.[27] In terms of ablation procedures, numbers for the Asian Pacific region (Japan 871 and Taiwan 270 per million people) were lower compared with Europe (Germany 1570 and Belgium 1377 per million people). It was similar for ICD implantations: Singapore (65 per million people) and Brunei (64 per million people) compared with Czechia (426 per million people) and Cyprus (300 per million people). Reasons for these differences are unclear but may reflect differences in clinical guidelines and population health among others.

Table 1 Number of ESC member countries reporting the indicated methods and entities of reimbursement for electrophysiology procedures, cardiac implantable electronic devices, and remote monitoring

Procedure/device	Fully reimbursed by mandatory public insurance	Fully reimbursed by voluntary private insurance	Partially reimbursed by mandatory private insurance + copayment	Reimbursement decided on a case-by-case basis	Patient private expenditure (out-of-pocket)	Technology not available
Pacemaker (standard or CSP)	38	2	5	1	0	0
Leadless pacemaker	25	1	2	8	2	7
ICD	36	2	5	3	0	0
Subcutaneous or extravascular ICD	25	2	2	6	1	8
CRT-P	37	2	4	3	0	0
CRT-D	35	2	5	4	0	0
ILR	36	2	5	3	0	0
Conventional ablation	37	2	5	2	0	0
3D-ablation	34	2	2	4	1	2
Single-shot AF ablation	32	2	2	4	0	3
Remote follow-up of ICD/CRT-D	25	0	0	4	2	9
Remote follow-up of other CIEDs	22	1	0	5	3	10
Wearable ICD	11	0	0	3	4	26

AF, atrial fibrillation; CIED, cardiac implantable electronic device; CRT, cardiac resynchronization therapy; CSP, conduction system pacing; ICD, implantable cardioverter-defibrillator; ILR, implantable loop recorder;

Table 2 Barriers reported in the implementation of ESC guidelines

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
There is a lack of EP/CIED hospitals in the country	1	11	7	19	12
There is a lack of guidelines awareness in the country	1	8	6	22	12
There is a lack of EP/CIED patients referral in the country	3	10	8	18	10
There is a lack of EP/CIED reimbursement system in the country	6	14	9	13	8
There is lack of access to technology in the country	5	12	10	14	8

EP, electrophysiology; CIED, cardiac implantable electronic device.

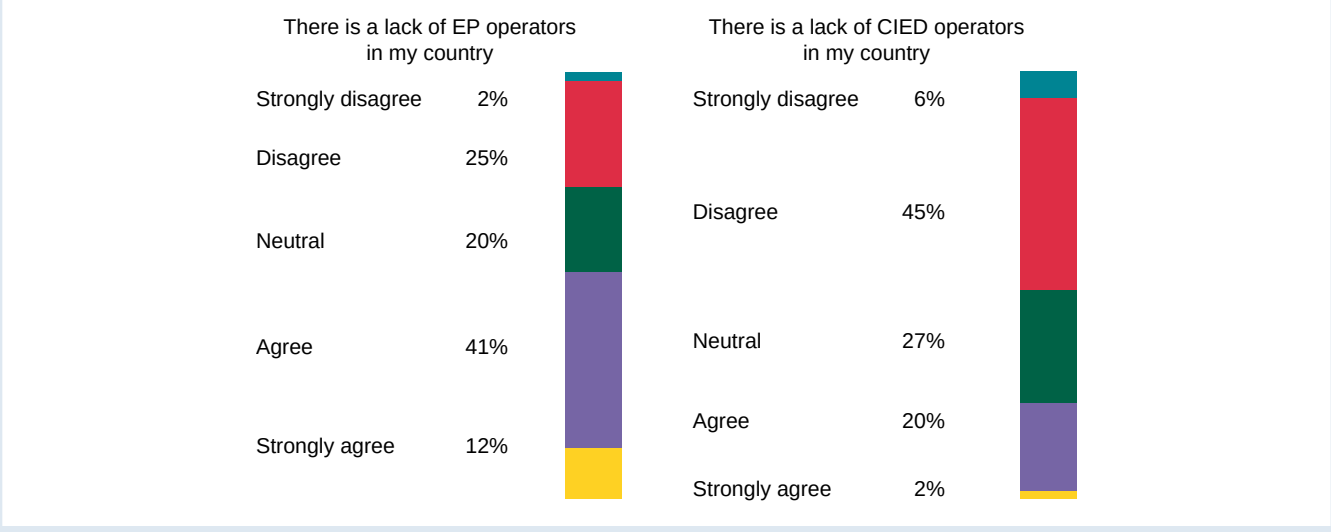

Figure 11 Perceived lack of electrophysiology or cardiac implantable electronic devices operators. Missing data: Republic of Moldova, UK.

Strengths and limitations

The data were collected through a survey distributed to the EP National Cardiac Societies, Working Groups, and other relevant EHRA partners. Some data sources, such as estimations and personal communications, are more susceptible to subjective interpretation and variability. Data completeness varied among countries. Generally, countries without robust central insurance institutions or established national registries were disadvantaged and sometimes struggled to deliver accurate and complete data sets. Furthermore, the ESC-EHRA Atlas on Heart Rhythm Disorders does not provide information on within-country inequalities. The Atlas Task Force provided definitions for all variables, but the possibility that some of those definitions were unclear or misinterpreted cannot be overlooked. This was the first edition of the ESC-EHRA Atlas on Heart Rhythm Disorders, which was developed and prepared using current methodology. Therefore, comparisons to the 2017 EHRA White Book data are not justified. The current project focused on procedural volumes and resource availability rather than procedural effectiveness/safety or patient outcomes; therefore, the data presented should be interpreted accordingly.

Conclusions

The 2025 ESC-EHRA Atlas on Heart Rhythm Disorders is the inaugural edition of a newly revitalized EHRA White Book project, methodologically aligned with the ESC Atlas Project.[23] The ESC-EHRA Atlas provides comprehensive data on healthcare delivery and access to medical technologies related to heart arrhythmias across 51 ESC member countries, based on data from 2023 or the most recent available year. The number of healthcare professionals, rates of EP and CIED procedures per million people, and access to various medical technologies vary among the respondent countries. Such discrepancies, in the light of the universally recognized ESC clinical guidelines, highlight significant inequalities in patient access to arrhythmia healthcare services throughout the ESC. One of the primary objectives of the ESC-EHRA Atlas is to identify and describe those inequalities, thereby assisting local EP National Cardiac Societies, Working Groups, and other EHRA partners in their endeavours to enhance arrhythmia care in their respective countries.

Supplementary material

Supplementary material is available at *Europace* online.

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Data availability

All the data presented in this report are available upon reasonable request to the corresponding author (M.M.F.). Access will be granted following review with ESC-EHRA Atlas on Heart Rhythm Disorders investigators and agreement with the authors of this manuscript.

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