Europace (2015) **17**, iv1–iv72
doi:10.1093/europace/euv265

CLINICAL RESEARCH

Current trends in the use of cardiac implantable electronic devices and interventional electrophysiological procedures in the European Society of Cardiology member countries: 2015 report from the European Heart Rhythm Association

M.J. Pekka Raatikainen[1]*, David O. Arnar[2], Katja Zeppenfeld[3], Jose Luis Merino[4], Karl-Heinz Kuck[5], and Gerhardt Hindricks[6]

[1]Department of Medicine Division of Cardiology, Central Finland Health Care District, Jyväskylä and University of Eastern Finland, Building 1 D/9, FI-40620 Jyväskylä, Kuopio, Finland; [2]The Heart Centre, Department of Medicine, Landspitali – The National University Hospital, Reykjavik, Iceland; [3]Department of Cardiology, Leiden University Medical Centre, Leiden, Netherlands; [4]Unidad Electrofisiologia Cardiaca Robotizada-Hospital Universitario La Paz, Madrid, Spain; [5]Department of Cardiology, Ak St. Georg, Hamburg, Germany; and [6]Department of Electrophysiology, Heart Centre, University of Leipzig, Leipzig, Germany

Received 9 July 2015; accepted after revision 10 July 2015

Aims The aim was to provide comprehensive information on the use of cardiac implantable electronic device (CIED) and catheter ablation therapy in the European Society of Cardiology (ESC) area.

Methods and results The European Heart Rhythm Association (EHRA) has collected data on use of invasive arrhythmia managements since 2008. Fifty-one of the 56 ESC member countries provided data for the EHRA White Book 2015. This analysis is based on the current and previous editions of the EHRA White Book. Up-to-date information on procedure rates for the last 5 years together with information on economic resources, reimbursement systems, and training requirements are presented for each country and the five geographical ESC regions. In 2014, the CIED implantation rates per million population were highest in the Western followed by the Southern and Northern European countries. The catheter ablation activity was largest in the Western followed by the Northern and Southern areas. Altogether the procedure rates were lowest in the Eastern European and in the non-European ESC countries. In the European ESC countries, the procedure rates were 3–10 times higher than in the non-European ESC countries. However, in some countries with a relatively low gross domestic product the procedure rates exceeded the average values indicating that utilization of arrhythmia therapies was not driven merely by the economic factors.

Conclusion This analysis indicates that considerable heterogeneity in the availability and utilization of arrhythmia therapies still exist across the ESC area. The data will hopefully aid in directing future activities and promote harmonization of cardiac arrhythmia care in the ESC countries.

Keywords Pacemaker • Implantable cardioverter-defibrillator (ICD) • Cardiac resynchronization therapy pacemaker (CRT-P) • Cardiac resynchronization therapy defibrillator (CRT-D) • Catheter ablation • Atrial fibrillation ablation

* Corresponding author. Tel: +358 40 5881304. *E-mail address*: pekka.raatikainen@fimnet.fi

Introduction

The European Heart Rhythm Association (EHRA) White Book has been the key source for information on various electrophysiological procedure rates in the European Society of Cardiology (ESC) member countries since 2008. The objective of the current analysis is to provide comprehensive information on the trends in the use of cardiac implantable electronic device (CIED) and catheter ablation therapy in the ESC area over the last 5 years. The analysis provides each country with the ability to see its own data in an international context. As previously,[1–3] we have provided not only statistics on a variety of electrophysiological procedures, but also information on the social, financial, and economic aspects in the constituent ESC countries. It is hoped that these data will help clarify whether financial restrictions influence the delivery of arrhythmia care. In addition to the collective data, statistics for the four geographical European (Northern, Western, Eastern, and Southern) ESC regions and for the non-European ESC countries are presented separately in order to facilitate comparisons between and within these geographical areas (*Figure 1*). Distribution of population within these regions over the last 5 years is presented in *Table 1*.

Our analysis revealed that considerable differences in the CIED implantation and catheter ablation rates between the ESC member countries still exist. As in previous years, the mean CIED implantation and catheter ablation rates per million population were higher in the Western Europe than in the other regions. Altogether the mean numbers were lowest in the Eastern Europe and in the non-European ESC countries. However, in some countries with relative low gross domestic product (GDP) the procedure rates exceeded the average values by far suggesting that GDP is not the only driver for utilization of device therapies. In most non-European ESC countries, the number of catheter ablations was markedly lower than in the European ESC regions. Of particular interest was that the rate of atrial fibrillation (AF) catheter ablation was ~10 times lower in the non-European vs. European ESC countries. Whether this is due to economic restrictions or to differences in patient selection criteria remains to be established.

European Heart Rhythm Association Certification and Training Fellowship Programmes play an important role with regard to EHRA's goal to promote unified standards for the training of cardiac rhythm management specialists and to assure high quality in arrhythmia care across the ESC area. Last year ~300 physicians and allied professionals participated in the EHRA Certification Examination. The EHRA Training Fellowship committee awarded several grants for young physicians mainly from emerging economies to be trained in high-volume centres outside of their home country. In addition, last year a specific proctor programme was initiated in order to provide further education in the field of cardiac arrhythmia management.

European Heart Rhythm Association has collected information on the resources and characteristics of procedures performed throughout the ESC area in the field of cardiac arrhythmias for almost a decade. The White Book data have formed a backbone for many strategic initiatives and awareness activities of the EHRA.

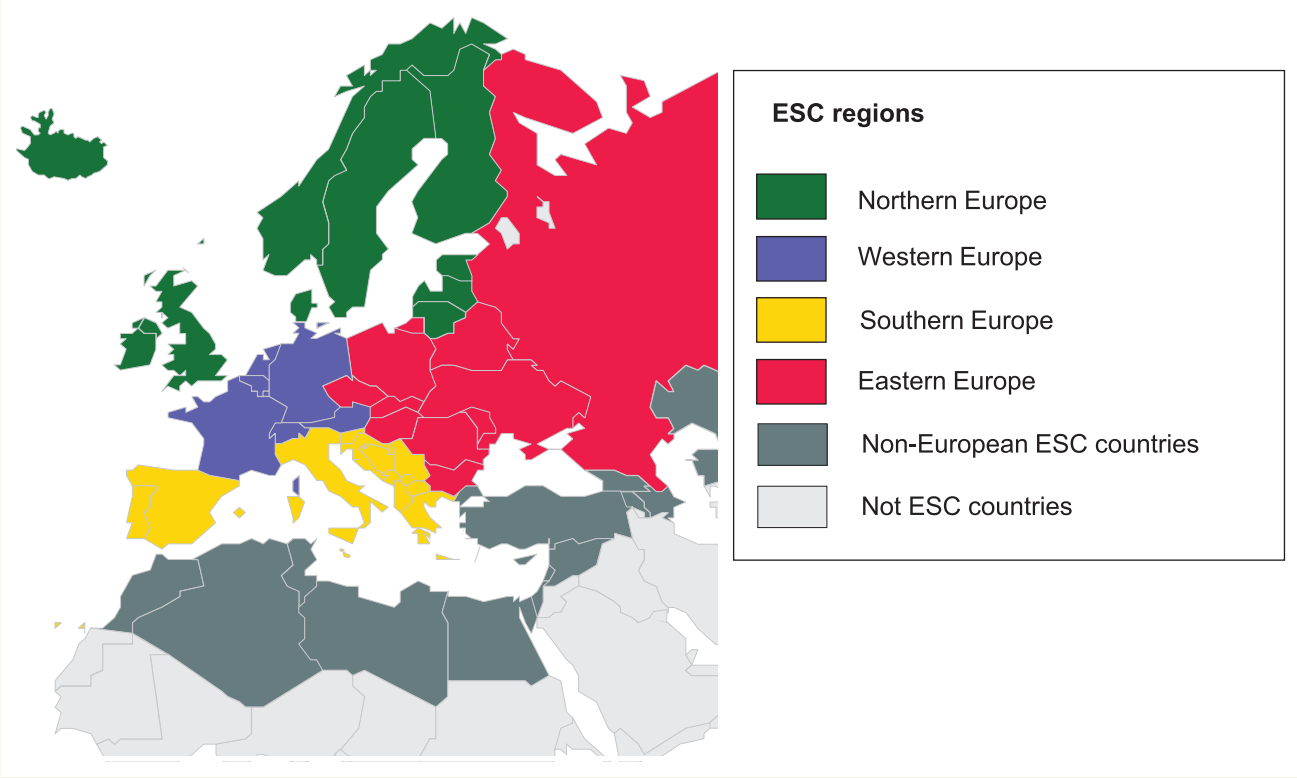

Figure 1 Geographic representation of the 56 ESC countries. The European regions were composed according to the UN Statistics Division (http://unstats.un.org/unsd/methods/m49/m49regin.htm).

Table 1 Populations in the five geographical ESC regions in 2010–14

Region	Country	ISO code	2010	2011	2012	2013	2014
Northern Europe	Denmark	DK	5 515 575	5 529 888	5 543 453	5 556 452	5 569 077
	Estonia	EE	1 291 170	1 282 963	1 274 709	1 266 375	1 257 921
	Finland	FI	5 255 068	5 259 250	5 262 930	5 266 114	5 268 799
	Iceland	IS	308 910	311 058	313 183	315 281	317 351
	Ireland	IE	4 622 917	4 670 976	4 722 028	4 775 982	4 832 765
	Latvia	LV	2 083 703	2 204 708	2 191 580	2 178 443	2 165 165
	Lithuania	LT	3 545 319	3 535 547	3 525 761	3 515 858	3 505 738
	Norway	NO	4 676 305	4 691 849	5 000 000	5 085 582	5 147 792
	Sweden	SE	9 074 055	9 088 728	9 103 788	9 647 386	9 723 809
	United Kingdom	GB	62 348 447	62 698 362	63 047 162	63 395 574	63 742 977
Total			98 721 469	99 273 329	99 984 594	101 003 047	101 531 394
Western Europe	Austria	AT	8 214 160	8 217 280	8 219 743	8 221 646	8 223 062
	Belgium	BE	10 423 493	10 431 477	10 438 353	10 444 268	10 449 361
	France	FR	64 768 389	65 102 719	65 630 692	65 951 611	66 259 012
	Germany	DE	81 644 454	81 471 834	81 305 856	81 147 265	80 996 685
	Luxembourg	LU	497 538	503 302	509 074	514 862	520 672
	Netherlands	NL	16 783 092	16 653 734	16 730 632	16 805 037	16 877 351
	Switzerland	CH	7 623 438	7 639 961	7 925 517	7 996 026	8 061 516
Total			189 954 564	190 020 307	190 759 867	191 080 715	191 387 659
Eastern Europe	Belarus	BY	9 612 632	9 577 552	9 643 566	9 625 888	9 608 058
	Bulgaria	BG	7 148 785	7 093 635	7 037 935	6 981 642	6 924 716
	Czech Republic	CZ	10 201 707	10 190 213	10 177 300	10 609 762	10 627 448
	Hungary	HU	9 992 339	9 976 062	9 958 453	9 939 470	9 919 128
	Moldova	MD	3 731 799	3 694 121	3 656 843	3 619 925	3 583 288
	Poland	PL	38 463 689	38 441 588	38 415 284	38 383 809	38 346 279
	Romania	RO	21 959 278	21 904 551	21 848 504	21 790 479	21 729 871
	Russian Federation	RU	139 390 205	138 739 892	142 517 670	142 500 482	142 470 272
	Slovakia	SK	5 470 306	5 477 038	5 483 088	5 488 339	5 492 677
	Ukraine	UA	45 415 596	45 134 707	45 416 589	44 573 205	44 291 413
Total			291 386 336	290 229 359	294 155 232	293 513 001	292 993 150
Southern Europe	Albania	AL	3 204 000	2 994 667	3 002 859	3 011 405	3 020 209
	Bosnia & Herzegovina	BA	4 621 598	4 622 163	3 879 296	3 875 723	3 871 643
	Croatia	HR	4 486 881	4 483 804	4 480 043	4 475 611	4 470 534
	Greece	GR	10 749 943	10 760 136	10 767 827	10 772 967	10 775 557
	Italy	IT	60 748 965	61 016 804	61 261 254	61 482 297	61 680 122
	Kosovo	XK	1 815 048	1 825 632	1 836 529	1 847 708	1 859 203
	Macedonia, FYR	MK	2 072 086	2 077 328	2 082 370	2 087 171	2 091 719
	Malta	MT	406 771	408 333	409 836	411 277	412 655
	Montenegro	ME	666 730	661 807	657 394	653 474	650 036
	Portugal	PT	10 735 765	10 760 305	10 781 459	10 799 270	10 813 834
	San Marino	SM	31 477	31 817	32 140	32 448	32 742
	Serbia	RS	7 344 847	7 310 555	7 276 604	7 243 007	7 209 764
	Slovenia	SI	2 003 136	2 000 092	1 996 617	1 992 690	1 988 292
	Spain	ES	46 505 963	46 754 784	47 042 984	47 370 542	47 737 941
Total			155 393 210	155 708 227	155 507 212	156 055 590	156 614 251
Non-European ESC countries	Algeria	DZ	33 769 669	34 994 937	37 367 226	38 087 812	38 813 722
	Armenia	AM	2 966 802	2 967 975	2 970 495	3 064 267	3 060 927
	Azerbaijan	AZ	9 301 673	9 397 279	9 493 600	9 590 159	9 686 210
	Cyprus	CY	1 102 677	1 120 489	1 138 071	1 155 403	1 172 458
	Egypt	EG	80 471 869	82 079 636	83 688 164	85 294 388	86 895 099
	Georgia	GE	4 600 825	4 585 874	4 570 934	4 942 157	4 935 880
	Israel	IL	7 353 985	7 473 052	7 590 758	7 707 042	7 821 850
	Kazakhstan	KZ	17 084 817	17 304 513	17 736 896	17 736 896	17 948 816
	Kyrgyzstan	KGZ	5 410 468	5 450 776	5 496 737	5 548 042	5 604 212
	Lebanon	LB	4 125 247	4 143 101	4 140 289	4 131 583	4 136 895
	Libya	LY	6 173 579	6 597 960	5 613 380	6 002 347	6 244 174
	Morocco	MA	31 627 428	31 968 361	32 309 239	32 649 130	33 478 299
	Syria	SY	22 198 110	22 517 750	22 530 746	22 457 336	22 597 531
	Tunisia	TN	10 525 041	10 629 186	10 732 900	10 835 873	10 937 521
	Turkey	TR	77 804 122	78 785 548	79 749 461	80 694 485	81 619 392
Total			314 516 312	320 016 437	325 128 896	329 896 920	334 952 986
Total ESC countries		56	1 049 971 891	1 055 247 659	1 065 535 801	1 071 549 273	1 077 479 440

We hope that the current statistics together with economic information will help to us to direct more resources towards cardiac arrhythmia management and to promote EHRA's goal to champion equity of access to modern cardiac arrhythmia therapy.

Societal, financial, and economic aspects

In this section, we have provided an overview of the demographic and financial profile of the 56 ESC countries.

General information

Population and vital statistics and GDP in the 56 ESC countries are presented in *Table 2*. European Society of Cardiology countries are a heterogeneous group of nations with varying political, financial, and demographic characteristics. In addition, there are large variations in the organizational aspects of healthcare across the ESC member countries. Some countries provide national healthcare services with full coverage to the whole population while in others healthcare services are primarily delivered by commercial health insurance companies and coverage depends on private co-payments (*Table 3*).

Medium to high quality data on cause of death are available in most ESC countries, although they are lacking in many other parts of the world.[4] The World Health Organization (WHO) National Health Account Database[5] has revealed important differences in the demographic and GDP data between the ESC countries. As an example, the life expectancy at birth varied from 69.1 years (Ukraine) to 83.2 years (San Marino). The death rate per 1000 population was lowest in Turkey (5.06%) and highest in Ukraine (14.60%). It is noteworthy that in most countries with life expectancy over 80 years, the GDP per capita is also relatively high (*Table 2*). Total GDP ranged from 2 (San Marino) to 3.820 (Germany) trillion US dollars (USD). The GDP per capita was almost 100 times higher in Luxembourg (116.752 USD) than in Kyrgyzstan (1.342 USD). Given these huge financial disparities, it was perhaps not surprising that there were large variations in device implantation rates and use of catheter ablation therapies across the ESC regions.

Healthcare resources

Healthcare expenditure per country is shown as percentage of the national GDP in *Figure 2* and as expenditure per capita in *Figure 3*. In the ESC countries, the mean healthcare expenditure was 8.3% of the GDP. It was highest in the Netherlands (12.4%) and lowest in Kazakhstan (4.2%). Given the trend towards a progressive ageing of populations, there is pressure to increase the healthcare expenditure. Despite this, the mean healthcare expenditure per capita in the ESC area was reduced from 2.818 USD in 2011 to 2.509 USD in 2012. According to the WHO statistics, the healthcare expenditure per capita in the ESC area was highest in Switzerland (9531 USD) and lowest in Kyrgyzstan (96 USD). Hence, there was ~100-fold difference between the lowest and the highest healthcare expenditure per capita.

The number of hospitals and hospital beds available for healthcare is shown in *Figure 4*. The number of hospitals and beds were not directly related to the financial profile of the countries or to healthcare expenditure. Rather, these data indicate that some countries have directed more resources towards hospital care than ambulatory and home care. For example, the number of beds per 100 000 inhabitants was 822 in Germany and only 271 in Sweden, despite the relatively high GDP and healthcare expenditure in both countries.

In most ESC countries, patients provide minimum-to-no co-payment for invasive electrophysiology (EP) procedures (*Table 3*). In countries where a co-payment exists, it may be one of the factors limiting access to CIED and catheter ablation therapies. However, as both the financial profile and the organization of healthcare in the ESC countries are heterogeneous, the impact of co-payment to implementation of interventional electrophysiological procedures in clinical practice is rather difficult to evaluate.

Certification of professional excellence

General information

In 2014, 48 countries (86% of the ESC member countries) provided data on certification of physicians and allied professionals in device therapy and invasive EP for the EHRA White Book 2015.[6] A national certification programme for device therapy for physicians was in use in 25 countries, and certification was mandatory in 12 countries (*Figure 5*). A national certification programme for invasive EP was available in 24 countries, and certification was an obligatory practice requirement in 13 countries (*Figure 6*). As shown in *Figure 7*, a national certification for allied professionals was available in 16 countries and was required for practice in 12 countries. Training centres were accredited in 17 (30%) countries, and certification of training centres was mandatory in order to train fellows in 9 countries (*Figure 8*). Several centres in various regions were available as training centres for the EHRA Training Fellowship Programme and allowed many young physicians from emerging economies to be trained in high-volume centres abroad.

European Heart Rhythm Association certification

The EHRA certification programme is the first European certification of professional excellence in the field of CIED therapies and invasive EP. The programme is designed to test theoretical knowledge and practical experience of professionals in cardiac device therapy and EP. Between 2005 and 2014, more than 1900 physicians [1138 in cardiac pacing and implantable cardioverter-defibrillators (ICDs) and 792 in invasive cardiac EP] from 58 countries have participated in the EHRA examination. In 2014, the majority of the 115 participants was male (77% in the invasive EP examination and 80% in the CIED programme) and had 31–40 years of age. Over the years, the proportion of female candidates has increased from <10% to ~25% (*Figure 9*). Last year, the highest number of candidates participating in the cardiac device therapy examination was from the Netherlands (27 candidates), Germany (17), and Switzerland (16). In the invasive EP examination, the highest numbers of participants were from Germany (18), Italy (17), and Spain (13).

Table 2 Population and vital statistics and GPD in the 56 ESC SC countries

Country	Population	Population growth rate (%)	Life expectancy at birth (years)	Death rate per 1000 population	GDP (×1000 billion USD)	GDP per capita (USD)	Total health expenditure as % of GDP	Total health expenditure per capita
Albania	3 020 209	0.29	78.00	5.68	13.59	4900	5.98	293
Algeria	38 813 722	1.91	76.40	N/A	227.80	5886	N/A	59
Armenia	3 060 927	−0.11	74.20	9.13	11.11	3373	4.50	152
Austria	8 223 062	0.02	80.20	9.12	436.07	51 183	11.48	5876
Azerbaijan	9 686 210	1.00	71.90	5.88	77.91	8303	5.40	448
Belarus	9 608 058	−0.19	72.20	12.66	77.17	8195	5.04	413
Belgium	10 449 361	0.05	79.90	9.70	527.81	47 164	10.80	5094
Bosnia & Herzegovina	3 871 643	−0.11	76.30	9.12	18.99	4905	9.90	486
Bulgaria	6 924 716	−0.82	74.30	14.96	55.08	7648	7.42	567
Croatia	4 470 534	−0.11	76.40	12.12	58.33	13 624	6.82	929
Cyprus	1 172 458	1.48	78.30	6.31	21.34	23 955	7.32	1753
Czech Republic	10 627 448	0.17	78.30	10.29	200.01	18 985	7.66	1454
Denmark	5 569 077	0.23	79.10	9.38	347.20	61 885	11.20	6931
Egypt	86 895 099	1.88	73.50	N/A	284.86	3337	N/A	33
Estonia	1 257 921	−0.67	74.10	11.35	26.36	19 777	5.94	1175
Finland	5 268 799	0.05	79.70	9.38	276.28	50 451	9.16	4621
France	66 259 012	0.47	81.70	8.61	2902.33	45 384	11.76	5337
Georgia	4 935 880	−0.13	75.70	10.71	16.13	3607	9.18	331
Germany	80 996 685	−0.19	80.40	10.62	3820.46	47 201	11.28	5324
Greece	10 775 557	0.02	80.30	9.83	246.40	22 318	9.28	2071
Hungary	9 919 128	−0.20	75.50	13.05	129.69	13 154	7.82	1029
Iceland	317 351	0.66	81.20	6.27	16.20	50 006	9.06	4531
Ireland	4 832 765	1.19	80.60	6.08	245.82	51 159	8.10	4144
Israel	7 821 850	1.49	81.30	5.24	304.98	37 914	7.52	2851
Italy	61 680 122	0.32	82.00	9.67	2129.28	35 512	9.18	3260
Kazakhstan	17 948 816	1.19	70.20	8.94	225.62	12 950	4.18	541
Kosovo	1 859 203	0.62	71.00	N/A	7.49	N/A	N/A	0
Kyrgyzstan	5 604 212	1.01	70.10	6.64	7.65	1342	7.14	96
Latvia	2 165 165	−0.61	73.40	14.28	32.82	16 145	6.00	969
Lebanon	4 136 895	0.13	75.70	N/A	47.50	10 531	N/A	105
Libya[a]	6 244 174	4.03	76.00	N/A	49.34	7942	N/A	79
Lithuania	3 505 738	−0.29	76.00	12.81	48.72	16 476	6.66	1097
Luxembourg	520 672	1.13	80.00	7.18	63.93	116 752	6.86	8009
FYR Macedonia	2 091 719	0.22	75.80	9.30	10.92	5262	7.14	376
Malta	412 655	0.34	80.10	7.86	10.26	24 314	9.10	2213
Moldova[a]	3 583 288	−1.01	70.10	11.11	7.74	2176	11.72	255
Montenegro	650 036	−0.53	78.30	9.29	4.66	7466	7.58	566
Morocco	33 478 299	2.54	76.50	N/A	112.55	3392	7.00	237
Netherlands	16 877 351	0.43	81.10	8.13	880.39	52 249	12.44	6500
Norway	5 147 792	1.22	81.60	8.35	511.60	99 295	9.02	8956
Poland	38 346 279	−0.10	76.70	9.75	552.23	14 330	6.72	963
Portugal	10 813 834	0.13	79.00	9.77	228.17	21 748	9.46	2057
Romania	21 729 871	−0.28	74.70	11.72	202.47	10 161	5.12	520
Russian Federation	142 470 272	−0.02	70.20	14.20	2057.30	14 317	6.26	896
San Marino[a]	32 742	0.91	83.20	7.34	1.86	N/A	6.54	0
Serbia	7 209 764	−0.46	75.00	14.22	42.65	5924	10.48	621
Slovakia	5 492 677	0.08	76.40	9.84	100.11	18 480	7.80	1441
Slovenia	1 988 292	−0.22	77.80	9.08	49.93	24 211	8.76	2121
Spain	47 737 941	0.78	81.50	8.41	1400.48	30 113	9.62	2897
Sweden	9 723 809	0.79	81.90	9.65	559.11	57 557	9.62	5537
Switzerland	8 061 516	0.82	82.40	8.01	679.03	84 344	11.30	9531
Syria[a]	22 597 531	0.62	75.40	N/A	N/A	N/A	N/A	0
Tunisia	10 937 521	0.94	75.70	N/A	49.12	4467	N/A	45
Turkey	81 619 392	1.15	73.30	5.06	813.32	10 518	6.30	663
Ukraine	44 291 413	−0.63	69.10	14.60	134.89	2979	7.56	225
United Kingdom	63 742 977	0.55	80.40	9.02	2847.60	44 141	9.44	4167

[a]These four countries did not submit data for the EHRA White Book 2015.

Table 3 Healthcare service and insurance systems in the 56 ESC countries

Country	Basic insurance availability	Uninsured citizens (% of population)	Distribution of insurance modality (%)			Possibility to subscribe private health insurance plans	Co-payment necessary for therapies		
			Public insurance	Private insurance	Private co-payment		ICD	PM	Ablation
Albania	Yes	30	100	0	0	N/A	No	No	No
Algeria	Yes	30	100	0	0	Yes	No	No	No
Armenia	No	75	0	100	0	Yes	No	No	No
Austria	Yes	2	65	0	35	Yes	No	No	No
Azerbaijan	Yes	0	80	10	10	Yes	Yes	No	Yes
Belarus	Yes	0	100	N/A	N/A	Yes	No	No	No
Belgium	Yes	1	90	0	10	Yes	No	No	Yes
Bosnia & Herzegovina	No	25	75	0	25	No	N/A	N/A	N/A
Bulgaria	Yes	20	75	1	24	Yes	Yes	No	Yes
Croatia	Yes	10	90	5	5	Yes	No	No	No
Cyprus	Yes	15	100	0	0	Yes	No	No	No
Czech Republic	Yes	0.1	99.8	0.1	0.1	No	No	No	No
Denmark	Yes	0	100	0	0	Yes	No	No	No
Egypt	No	33	64	1	35	Yes	No	No	No
Estonia	Yes	5	100	0	0	Yes	No	No	No
Finland	Yes	0	75.2	3	21.8	Yes	No	No	No
France	Yes	0	55	0	45	No	No	No	No
Georgia	Yes	N/A	N/A	N/A	N/A	Yes	Yes	Yes	Yes
Germany	Yes	1	87	11	2	Yes	No	No	No
Greece	Yes	20	89	10	1	Yes	No	No	No
Hungary	Yes	2	99	1	0	Yes	No	No	No
Iceland	Yes	0	100	0	0	No	No	No	No
Ireland	Yes	52	48	52	0	Yes	No	No	No
Israel	Yes	0	100	0	0	Yes	No	No	No
Italy	Yes	0	100	0	0	Yes	No	No	No
Kazakhstan	No	N/A	N/A	N/A	N/A	Yes	No	No	No
Kosovo	No	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Kyrgyzstan	Yes	N/A	N/A	N/A	N/A	No	Yes	Yes	Yes
Latvia	Yes	0	82	18	0	Yes	Yes	Yes	No
Lebanon	Yes	30	25	25	10	Yes	Yes	Yes	Yes
Libya[a]									
Lithuania	Yes	N/A	N/A	N/A	N/A	Yes	No	No	No
Luxembourg	Yes	0	100	N/A	N/A	Yes	No	No	No
Macedonia, FYR	Yes	10	80	10	10	Yes	No	No	No
Malta	Yes	0	90	0	10	Yes	No	No	No
Moldova[a]									
Montenegro	Yes	0	100	0	0	No	No	No	No
Morocco	No	30	80	15	5	Yes	No	No	No
Netherlands	Yes	0	0	100	0	Yes	No	No	No
Norway	Yes	0	98	0	2	Yes	No	No	No
Poland	Yes	5	90	5	5	Yes	No	No	No
Portugal	Yes	0	N/A	N/A	N/A	Yes	No	No	No
Romania	Yes	N/A	100	0	0	No	Yes	Yes	Yes
Russian Federation	Yes	N/A	85	15	N/A	Yes	No	Yes	No
San Marino[a]									
Serbia	Yes	0	100	0	0	Yes	No	No	No
Slovakia	Yes	0	72	28	0	Yes	No	No	No
Slovenia	No	1	4	0	96	N/A	No	No	No
Spain	No	5	83	15	2	Yes	No	No	No
Sweden	Yes	0	90	0	10	Yes	No	No	No
Switzerland	Yes	0	71	0	29	Yes	No	No	No
Syria[a]									
Tunisia	Yes	10	90	5	5	Yes	No	No	No
Turkey	Yes	1	99	1	N/A	Yes	No	No	No
Ukraine	No	N/A	N/A	N/A	N/A	Yes	No	No	No
United Kingdom	Yes	0	89	11	0	Yes	No	No	No

[a]These four countries did not submit data for the EHRA White Book 2015.

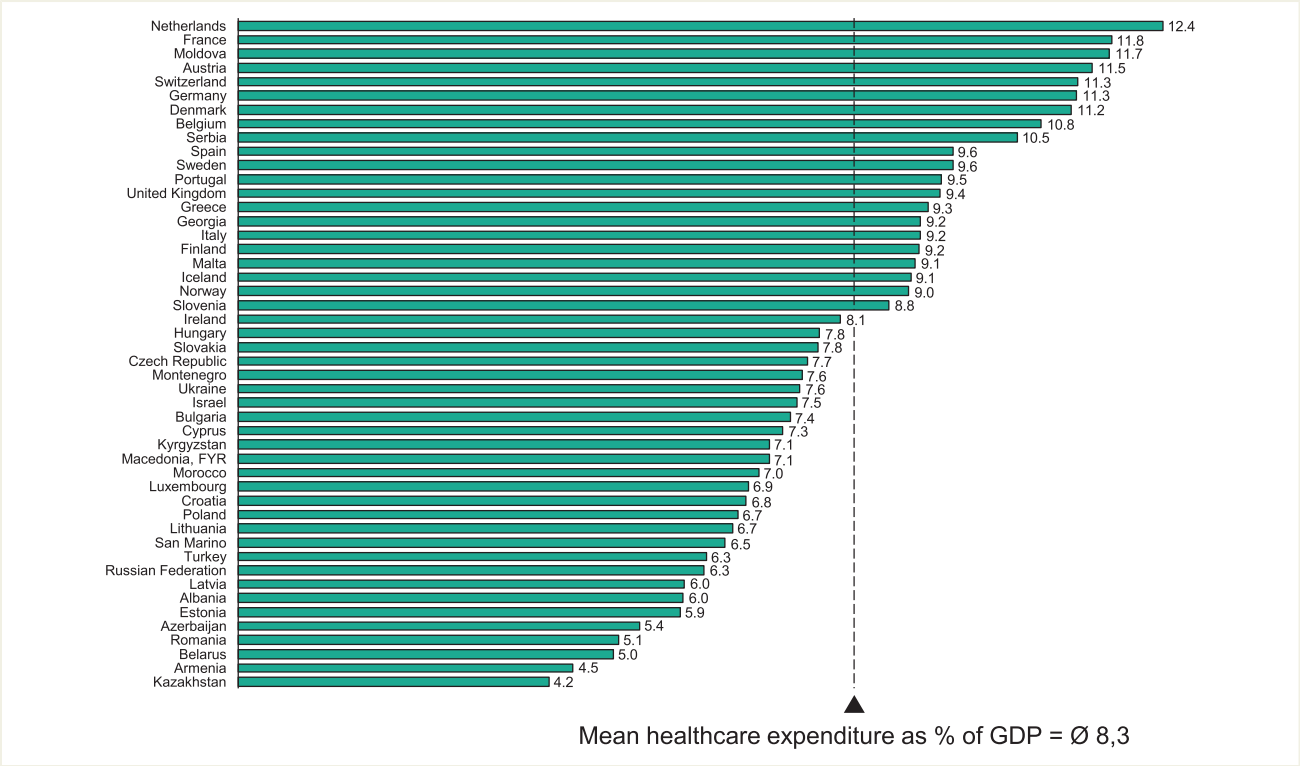

Figure 2 Healthcare expenditure as percentage of national GDP in the ESC member countries in 2012. The mean healthcare expenditure as % of GDP is weighted by population.

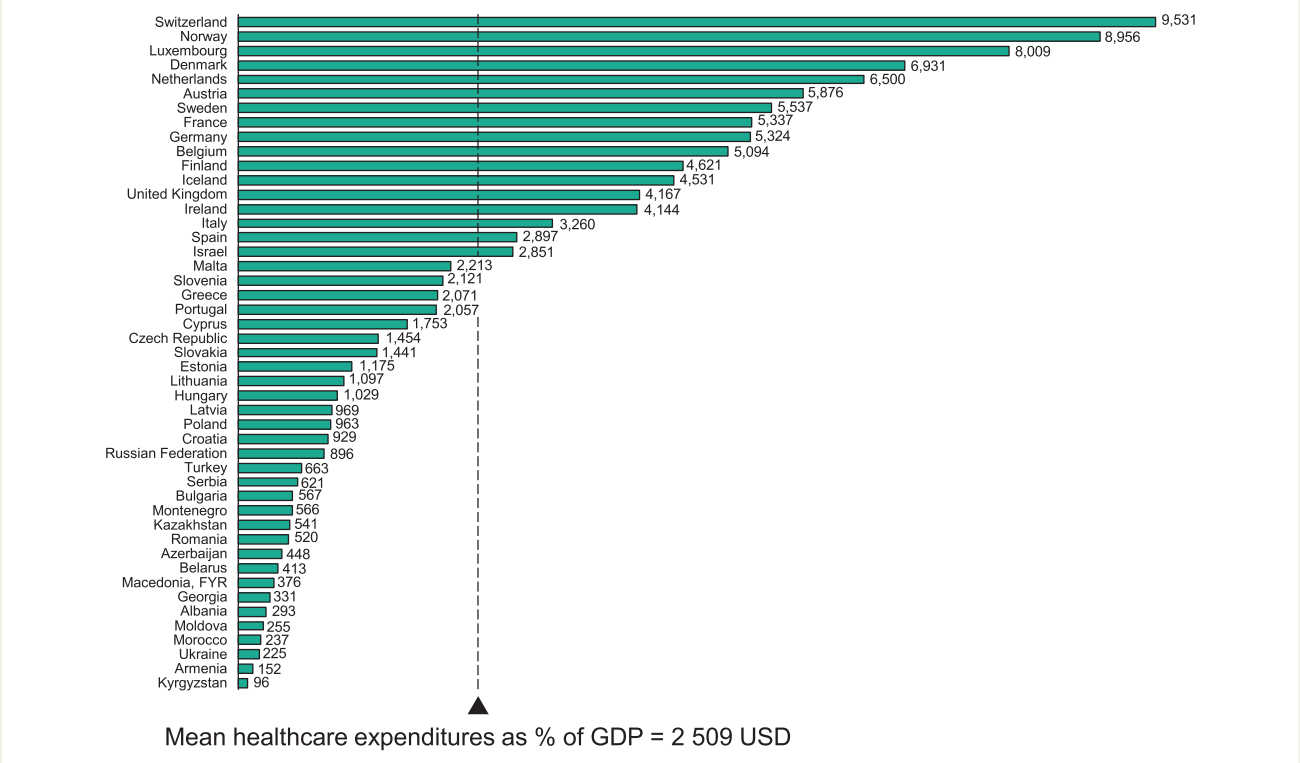

Figure 3 Healthcare expenditure per capita in the ESC countries in 2012. The mean number of expenditure is weighted by population.

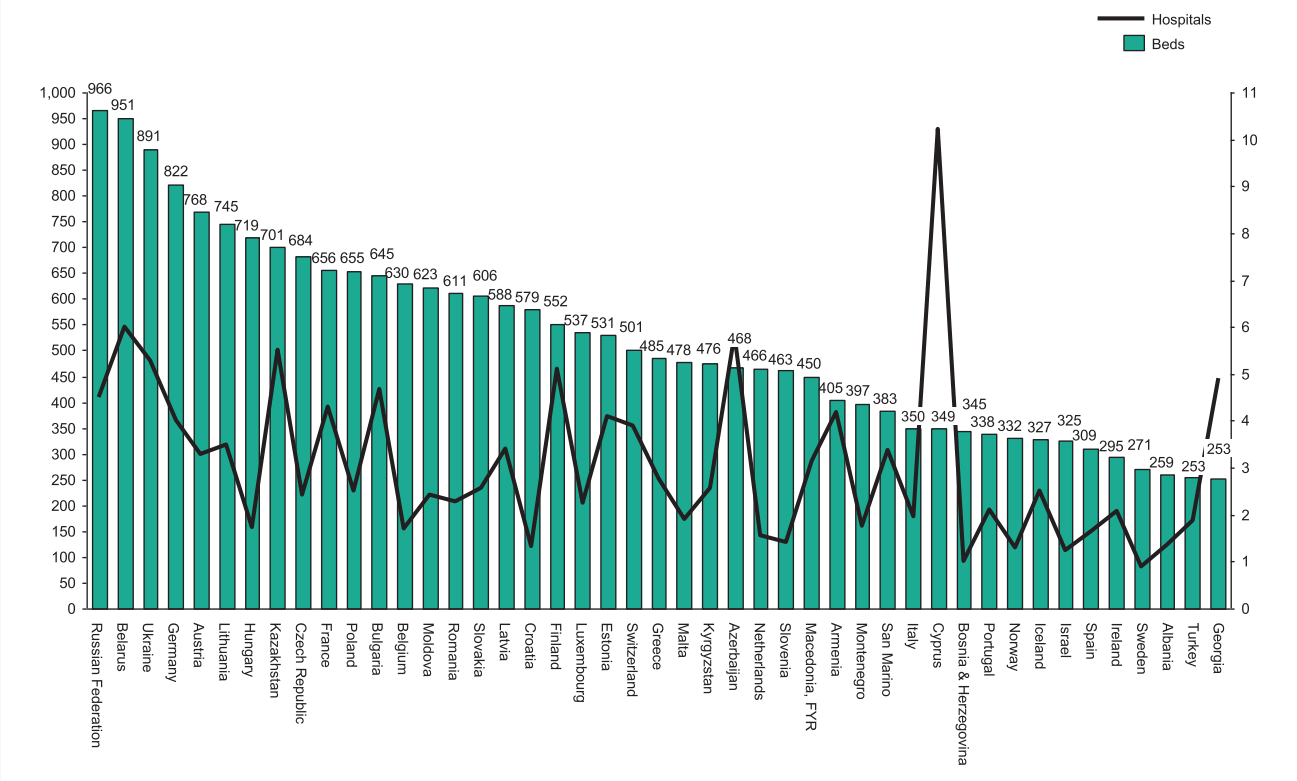

Figure 4 Hospitals and hospital beds per 100 000 inhabitants in the ESC countries.

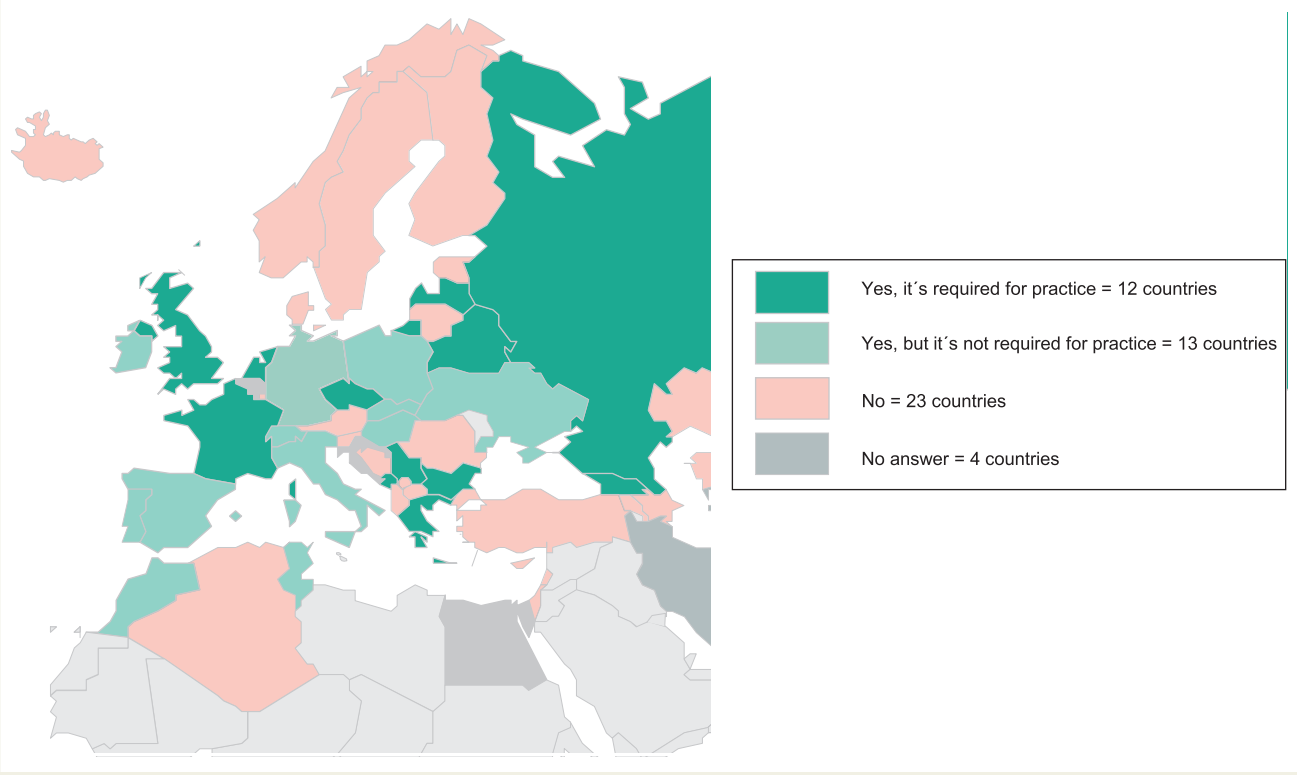

Figure 5 Certification for CIED therapy in the ESC countries in 2014.

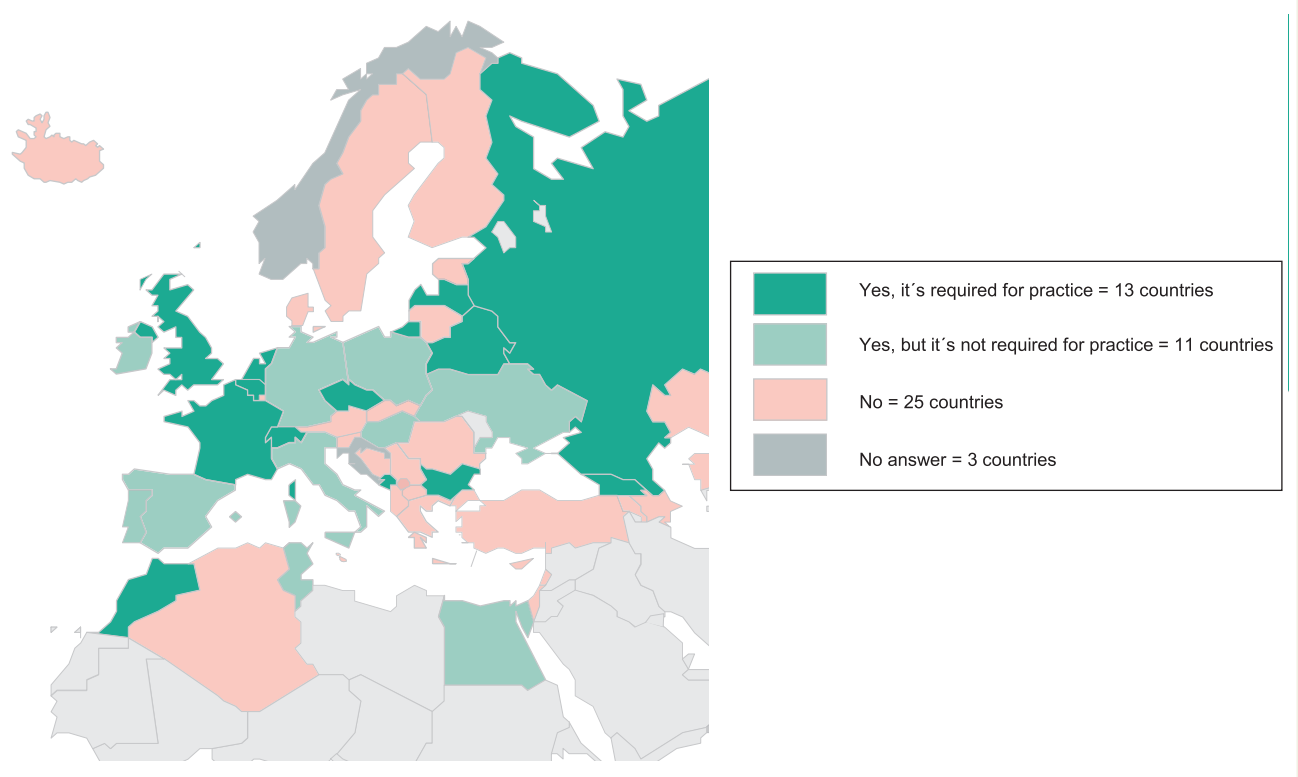

Figure 6 Certification for invasive EP in the ESC countries in 2014.

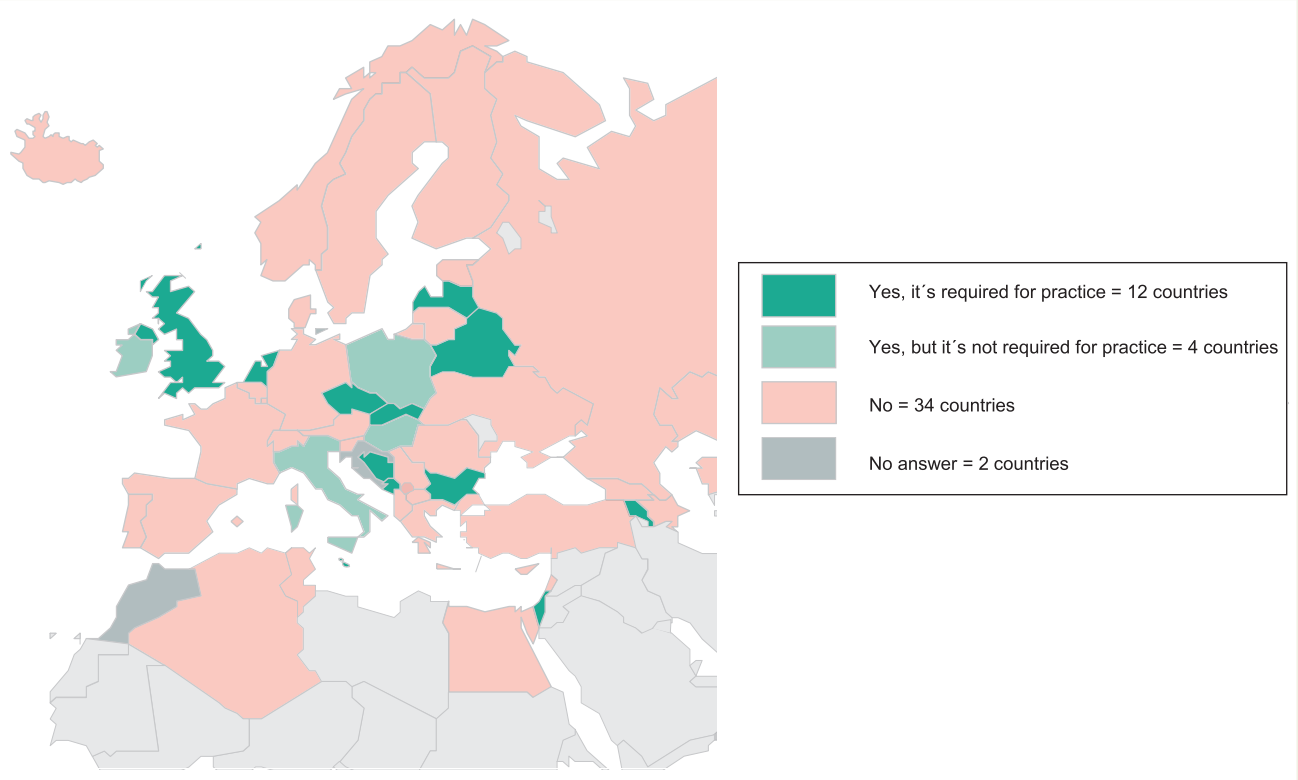

Figure 7 Certification for allied professionals in the ESC countries in 2014.

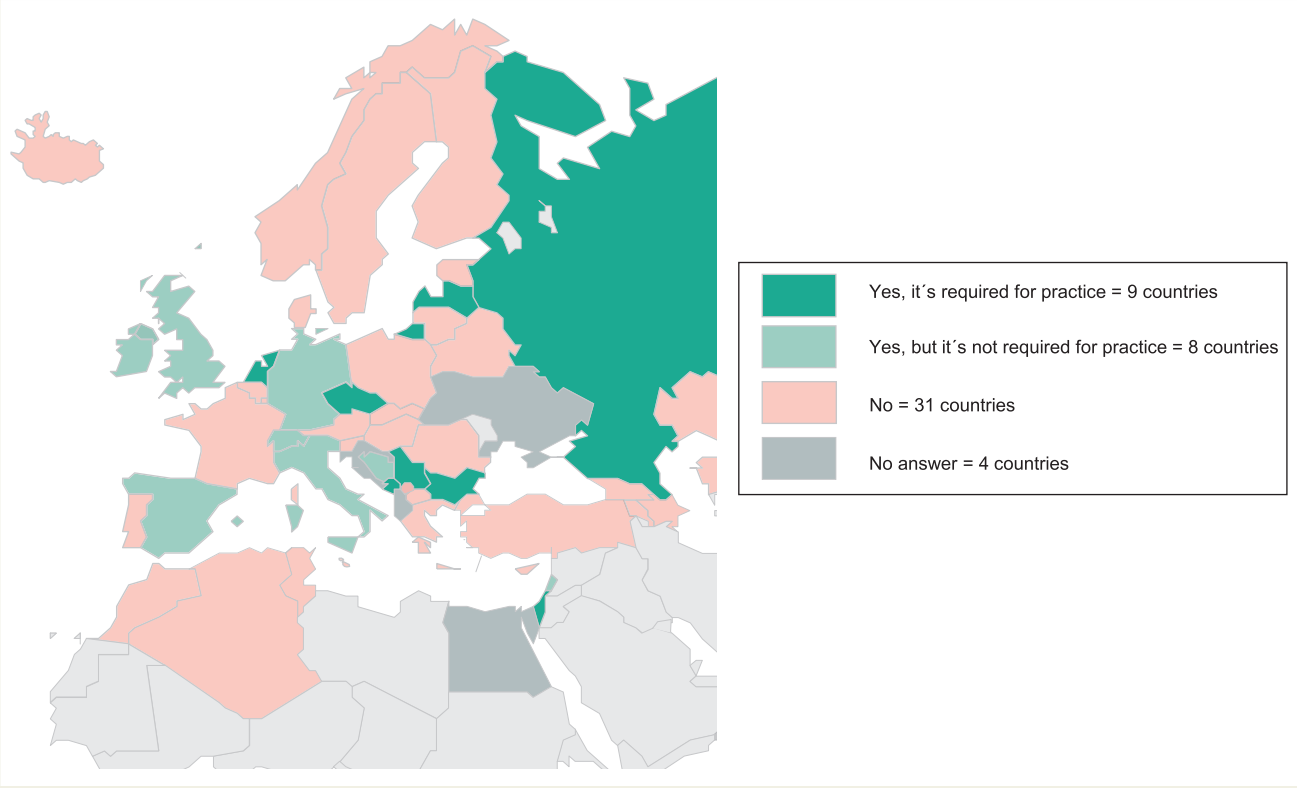

Figure 8 Certification for training centres in the ESC countries in 2014.

The pass rate was 49% for physicians participating in the invasive EP examination and was 51% for those participating in the cardiac device therapy examination. These numbers are somewhat lower than the pass rates from previous years. For example, in 2013, the corresponding pass rates for invasive EP and cardiac device therapy were 62% and 71%, respectively. Since the introduction of the EHRA examination, more than 1000 physicians (659 in cardiac device therapy and 361 in invasive EP) have passed the exam and have reached first level certification. More than two-thirds of them have submitted the case logbook within the required time period and subsequently achieved full (level 2) certification.

Since the introduction in 2011 of the EHRA certification programme for allied professionals in cardiac device therapy, 144 candidates from 14 countries have participated in the EHRA examination and 116 of them passed the examination and achieved full certification. Last year, the pass rate in the allied professional exam was 78%, which was markedly higher than in 2013 (61%). Every year, most participants have been from the Netherlands. For allied professionals, the examination is currently available in six languages (English, Spanish, French, German, Italian, and Greek).

In summary, the EHRA White Book data indicate that there are still significant differences in training and certification requirements between the ESC countries. Accordingly, there is a need to involve more physicians and allied professionals in the EHRA certification system to assure uniform and high level theoretical and practical training for all healthcare professionals, regardless of their country of origin. This is especially important in the EU because of the freedom of movement for doctors and allied professionals within the EU area.

Pacemakers

General information

The 51 countries (91% of all ESC member countries) which submitted the requested data on pacemaker (PM) implantation for the EHRA White Book are listed in *Table 4*. A national registry for PM implantations existed in 20 countries (*Table 4*). The vast majority of implants was performed by cardiologists, and the remaining implantations were performed by physicians with various training backgrounds, including surgeons, anaesthesiologists, paediatricians, and internists. In four countries (Austria, Iceland, Slovenia, and Ukraine), the proportion of implanting cardiologists was 50% or less (*Table 5*).

Pacemaker facilities and procedure rate

It was reported that in 3523 centres, a total of 526 213 PMs were implanted in 2014 (*Table 4*) slightly up from last year. The mean number of centres implanting PMs per million inhabitants was 3.7 slightly lower than the preceding year (*Figure 10*). The country with the highest density of implanting facilities was Germany (12.1 per million in habitants) followed by Belgium (10.0) and those with the lowest density were Egypt and Kyrgyzstan both with 0.4 per million and Morocco with 0.3 implanting centres per million inhabitants.

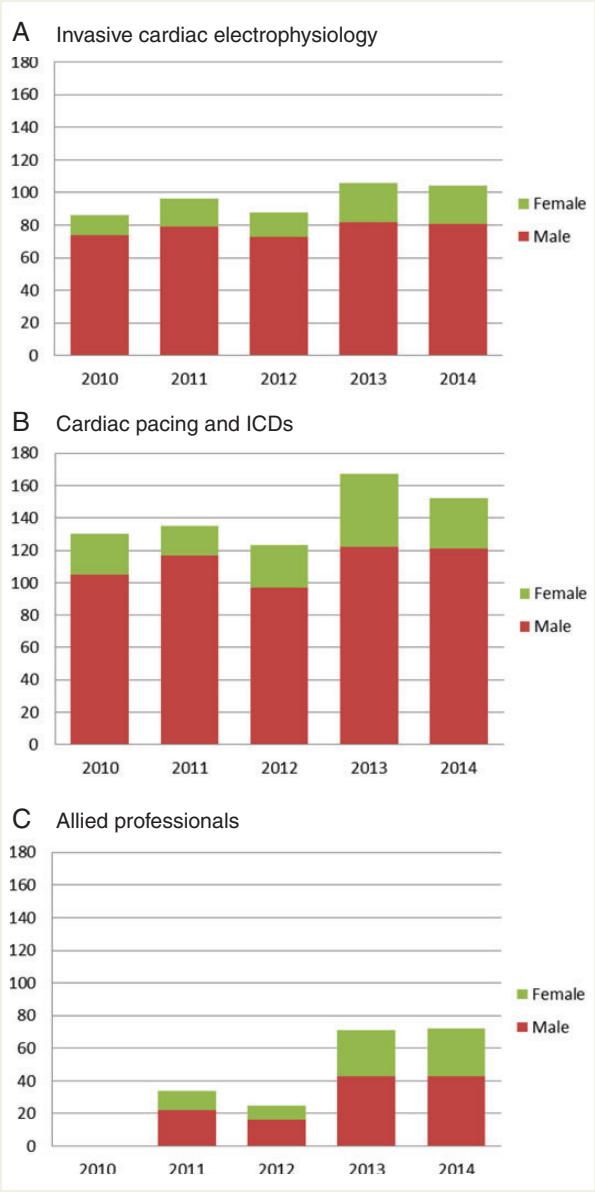

Figure 9 Number of participants in the EHRA examination during the last 5 years. ICD, implantable cardioverter-defibrillator.

In 2014, the mean PM implantation rate in the participating ESC countries was 506 PM units per million inhabitants. The implantation rates were highest in Belgium (1.236) and Germany (1.152), the two countries with the lowest implantation rate were Kyrgyzstan (22) and Azerbaijan (19). An overview of the PM implantation rate per million inhabitants for each country is shown in *Figures 11* and *12*. Across the 51 countries, marked heterogeneity was observed in the distribution of PM implantation rate per million inhabitants. This is in accordance with the White Book PM data from previous years.

The number of PM implantations according to the five ESC regions and the trend in implantation rate with comparison to the 28 European Union member countries (EU28) and the whole ESC area from 2009 to 2013 are shown in *Figure 13*. Countries with the highest and lowest activities in each region as well as yearly trends are shown in *Figures 14–18*. The number of PM implantations per million inhabitants was highest in the Western Europe, and lowest in the Eastern Europe and in the non-European ESC countries. The most active countries in each region were Belgium (1.218 per million inhabitants), Finland (1.051), Italy (1.029), Czech Republic (887), and Israel (537). These countries were also the most active last year.

The change in the number of implanting centres from 2013 to 2014 is presented in *Table 6* and *Figure 19*, and the change in the number of PM implantations per million inhabitants during the same period is presented in *Table 7* and *Figure 20*. The increase in the number of PM implantations was highest in Luxembourg (83.6%), Romania (77.9%), and Malta (60.7%). On the other hand, there was a 19.6% drop in the number of devices implanted in the Ukraine. The changes in the *de novo* PM implantation rate are shown separately in *Figure 21* and for PM generator replacements in *Figure 22*. The relationship between the mean annual PM implantation rate per million inhabitants and the number of PM implanting centres per million inhabitants in the 56 ESC countries and in the EU28 is shown in *Figure 23*.

Implantable cardioverter-defibrillators

General information

The 51 countries which submitted data for the EHRA White Book on ICDs in 2014 are listed in *Table 8*. Ireland, Libya, Moldova, San Marino, and Syria did not report data related to ICD implantations. In 25 countries, a national registry for ICD implantations was in use. The vast majority of implants was performed by cardiologists, and the remaining implantations were performed by physicians having various other training backgrounds, mainly surgical. However, in some countries (Austria, Slovenia, and Ukraine), the proportion of implanting cardiologists was $<50\%$ (*Table 5*).

Implantable cardioverter-defibrillator facilities and procedure rates

It was reported that in 2142 national centres, a total of 101 521 ICDs (16% more than in 2013) were implanted in 2014 (*Table 8*). *Table 8* also shows a comparison to previous years in each country. As seen in *Figure 24*, the mean number of implanting centres in the ESC area was 2.2 per country. In the ESC area, the mean number of ICD implantations per million inhabitants in 2014 was 99. In *Figures 25* and *26*, the ESC countries are grouped into quartiles according to the number of ICD implantations per million inhabitants. Germany (295 per million inhabitants), Italy (223), Finland (220), and Norway (220) had the highest implant rates while the lowest reported were in Albania, Morocco, and the Ukraine (1 per million inhabitants for each). Kyrgyzstan did not report any ICD implantations in 2014 (*Table 8* and *Figure 25*).

Table 4 Pacemaker implantation facilities and implantation rates in 2014 and comparison to four previous years

Country	ISO code	National registry for PM implants	Number of PM implanting centres 2014		PM implantations 2014		Development potential—target number of PM implantations		PM implantations per mil inhabitants				
			Absolute number	Per mil inhabitants	Absolute number	Per mil inhabitants	To attain mean ESC area level	To attain mean EU28 level	2010	2011	2012	2013	2014
Albania	AL	No	4	1	134	44	1528	2616	N/A	N/A	N/A	N/A	44
Algeria	DZ	No	19	0	2508	65	19 635	33 619	N/A	N/A	N/A	65	65
Armenia	AM	No	3	1	129	42	1548	2651	129	133	74	31	42
Austria	AT	Yes	57	7	8272	1006	–	–	939	950	957	967	1006
Azerbaijan	AZ	No	10	1	184	19	4900	8390	N/A	15	N/A	14	19
Belarus	BY	Yes	10	1	2970	309	4861	8322	237	258	275	292	309
Belgium	BE	Yes	104	10	12 912	1236	–	–	862	N/A	1228	1218	1236
Bosnia & Herzegovina	BA	No	5	1	831	215	1959	3353	167	138	234	224	215
Bulgaria	BG	Yes	17	2	3726	538	–	5998	345	385	448	503	538
Croatia	HR	No	18	4	2601	582	–	3872	522	565	561	540	582
Cyprus	CY	No	5	4	250	213	593	1016	209	223	211	216	213
Czech Republic	CZ	Yes	37	3	9447	889	–	–	873	881	899	887	889
Denmark	DK	Yes	11	2	4823	866	–	4824	749	795	841	850	866
Egypt	EG	No	33	0	3320	38	43 959	75 265	19	N/A	30	33	38
Estonia	EE	No	5	4	1054	838	–	1090	774	766	748	912	838
Finland	FI	No	20	4	5536	1051	–	–	936	923	990	1020	1051
France	FR	No	451	7	67 000	1011	–	–	991	969	958	910	1011
Georgia	GE	No	9	2	608	123	2497	4275	67	84	102	125	123
Germany	DE	No	980	12	93 315	1152	–	–	1267	1313	1311	1152	1152
Greece	GR	No	56	5	8000	742	–	9333	753	701	691	724	742
Hungary	HU	Yes	18	2	6393	645	–	8592	539	584	607	618	645
Iceland	IS	No	2	6	298	939	–	–	858	1006	967	996	939
Ireland	IE	Yes	17	4	N/A	N/A	N/A	N/A	404	507	451	479	N/A
Israel	IL	No	20	3	4200	537	–	6775	N/A	500	558	515	537
Italy	IT	Yes	433	7	63 442	1029	–	–	1044	1034	1001	1012	1029
Kazakhstan	KZ	No	22	1	2355	131	9080	15 547	N/A	N/A	69	84	131
Kosovo	XK	No	2	1	127	68	941	1610	N/A	N/A	N/A	N/A	68
Kyrgyzstan	KGZ	N/A	2	0	126	22	2835	4854	N/A	N/A	N/A	N/A	22

Latvia	LV	Yes	3	1	1236	571	–	1875	529	550	548	591	571
Lebanon	LB	No	15	4	900	218	2093	3583	N/A	N/A	N/A	218	218
Libya[a]	LY	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Lithuania	LT	No	4	1	2767	789	–	3037	671	714	756	772	789
Luxembourg	LU	No	5	10	349	670	–	451	183	336	621	365	670
Macedonia, FYR	MK	No	3	1	356	170	1058	1812	150	174	166	154	170
Malta	MT	No	1	2	366	887	–	–	703	740	644	552	887
Moldova[a]	MD	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	79	N/A
Montenegro	ME	No	1	2	182	280	329	563	243	264	218	312	280
Morocco	MA	Yes	11	0	1465	44	16 936	28 998	35	39	38	34	44
Netherlands	NL	Yes	83	5	10 132	600	–	14 619	594	585	560	605	600
Norway	NO	Yes	23	4	3887	755	–	4459	708	675	691	680	755
Poland	PL	No	150	4	28 470	742	–	33 214	715	710	716	716	742
Portugal	PT	Yes	39	4	8830	817	–	9367	759	595	825	814	817
Romania	RO	No	24	1	4258	196	10 993	18 822	114	139	144	110	196
Russian Federation	RU	Yes	140	1	37 832	266	72 073	123 403	193	216	212	244	266
San Marino[a]	SM	N/A	N/A	N/A	N/A	N/A	N/A	N/A	699	503	809	431	N/A
Serbia	RS	Yes	17	2	3657	507	–	6245	434	448	431	546	507
Slovakia	SK	Yes	13	2	3326	606	–	4758	547	617	567	630	606
Slovenia	SI	Yes	7	4	1464	736	–	1722	576	647	668	646	736
Spain	ES	Yes	230	5	36 322	761	–	41 349	755	734	738	749	761
Sweden	SE	Yes	45	5	9421	969	–	–	1005	N/A	1041	995	969
Switzerland	CH	Yes	76	9	6543	812	–	6983	745	791	753	763	812
Syria[a]	SY	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tunisia	TN	No	20	2	2200	201	5533	9474	143	155	233	N/A	201
Turkey	TR	No	N/A	N/A	7300	89	41 290	70 696	N/A	N/A	N/A	N/A	89
Ukraine	UA	No	36	1	5258	119	22 406	38 364	103	112	121	148	119
United Kingdom	GB	Yes	207	3	45 131	708	–	55 212	597	610	615	702	708
Total ESC countries	56		3523		526 213								

[a]These four countries did not submit data for the EHRA White Book 2015.

Table 5 Specialty of physicians performing device implantations and LEs in the 56 ESC countries

Country	ISO code	Specialist performing PM implantations (%)			Specialist performing ICD implantations (%)			Specialist performing CRT implantations (%)			Specialist performing loop recorder implantations (%)			Specialist performing LEs (%)		
		Cardiologists	Surgeons	Other	Cardiologists	Surgeons	Other	Cardiologists	Surgeons	Other	Cardiologists	Surgeons	Other	Cardiologists	Surgeons	Other
Albania	AL	100	0	0	100	0	0	100	0	0	0	0	0	0	0	0
Algeria	DZ	99	1	0	100	0	0	100	0	0	100	0	0	95	5	0
Armenia	AM	100	0	0	100	0	0	100	0	0	100	0	0	0	0	0
Austria	AT	50	50	0	10	90	0	50	50	0	80	20	0	10	90	0
Azerbaijan	AZ	64	36	0	100	0	0	100	0	0	100	0	0	100	0	0
Belarus	BY	0	100	0	0	100	0	0	100	0	0	100	0	0	100	0
Belgium	BE	N/A	N/A	N/A	N/A	N/A	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Bosnia & Herzegovina	BA	80	20	0	80	20	0	100	0	0	100	0	0	50	50	0
Bulgaria	BG	99	1	0	100	0	0	100	0	0	100	0	0	100	0	0
Croatia	HR	91	9	0	100	0	0	94	6	0	100	0	0	67	33	0
Cyprus	CY	100	0	0	100	0	0	100	0	0	100	0	0	100	0	0
Czech Republic	CZ	90	10	0	95	5	0	97	3	0	100	0	0	80	20	0
Denmark	DK	100	0	0	100	0	0	100	0	0	100	0	0	85	15	0
Egypt	EG	76	2	22	90	0	10	70	0	30	80	0	20	80	0	20
Estonia	EE	100	0	0	100	0	0	100	0	0	100	0	0	100	0	0
Finland	FI	95	5	0	100	0	0	100	0	0	100	0	0	50	50	0
France	FR	95	5	0	100	0	0	100	0	0	100	0	0	80	20	0
Georgia	GE	90	10	0	100	0	0	100	0	0	100	0	0	100	0	0
Germany	DE	N/A	N/A	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Greece	GR	97	3	0	98	2	0	98	2	0	100	0	0	90	10	0
Hungary	HU	90	5	5	95	2	3	95	2	3	100	0	0	95	5	0
Iceland	IS	50	50	0	50	50	0	75	25	0	100	0	0	50	50	0
Ireland	IE	100	0	0	100	0	0	100	0	0	100	0	0	50	50	0
Israel	IL	98	2	0	100	0	0	100	0	0	100	0	0	80	20	0
Italy	IT	100	0	0	100	0	0	100	0	0	100	0	0	100	0	0
Kazakhstan	KZ	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	0	0
Kosovo	XK	100	0	0	60	0	40	0	0	0	0	0	0	0	0	0
Kyrgyzstan	KGZ	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Latvia	LV	70	30	0	70	30	0	70	30	0	70	30	0	0	100	0
Lebanon	LB	75	20	5	75	25	0	100	0	0	100	0	0	80	20	0

Libya[a]	LY	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Lithuania	LT	99	1	0	100	0	0	100	0	0	100	0	0	83	17	0
Luxembourg	LU	85	15	0	97	3	0	95	5	0	100	0	0	0	100	0
Macedonia, FYR	MK	100	0	0	100	0	0	100	0	0	100	0	0	0	100	0
Malta	MT	100	0	0	100	0	0	100	0	0	100	0	0	100	0	0
Moldova[a]	MD	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Montenegro	ME	60	40	0	50	50	0	100	0	0	50	50	0	0	0	0
Morocco	MA	98	2	0	98	2	0	99	1	0	N/A	N/A	N/A	99	1	0
Netherlands	NL	90	5	5	90	5	5	90	5	5	80	0	20	90	10	0
Norway	NO	99.55	0.45	0	100	0	0	100	0	0	N/A	N/A	N/A	100	0	0
Poland	PL	98	1	1	100	0	0	99	1	0	100	0	0	95	5	0
Portugal	PT	99	1	0	99	1	0	100	0	0	100	0	0	N/A	N/A	0
Romania	RO	99	1	0	100	0	0	100	0	0	100	0	0	100	0	0
Russian Federation	RU	70	30	0	70	30	0	60	40	0	N/A	N/A	N/A	N/A	N/A	N/A
San Marino[a]	SM	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Serbia	RS	95	5	0	100	0	0	100	0	0	100	0	0	80	20	0
Slovakia	SK	70	30	0	100	0	0	100	0	0	100	0	0	100	0	0
Slovenia	SI	10	90	0	35	65	0	100	0	0	N/A	N/A	N/A	0	100	0
Spain	ES	72	24	4	92	8	0	98	2	0	100	0	0	20	80	0
Sweden	SE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Switzerland	CH	98	2	0	99	1	0	100	0	0	N/A	N/A	N/A	50	50	N/A
Syria[a]	SY	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tunisia	TN	95	5	0	100	0	0	100	0	0	100	0	0	40	60	0
Turkey	TR	97	3	0	99	1	0	99	1	0	100	0	0	75	25	0
Ukraine	UA	10.3	89.7	0	0	100	0	0	100	0	0	100	0	0	100	0
United Kingdom	GB	99	1	0	98	2	0	99	1	0	100	0	0	N/A	N/A	N/A

[a]These four countries did not submit data for the EHRA White Book 2015.

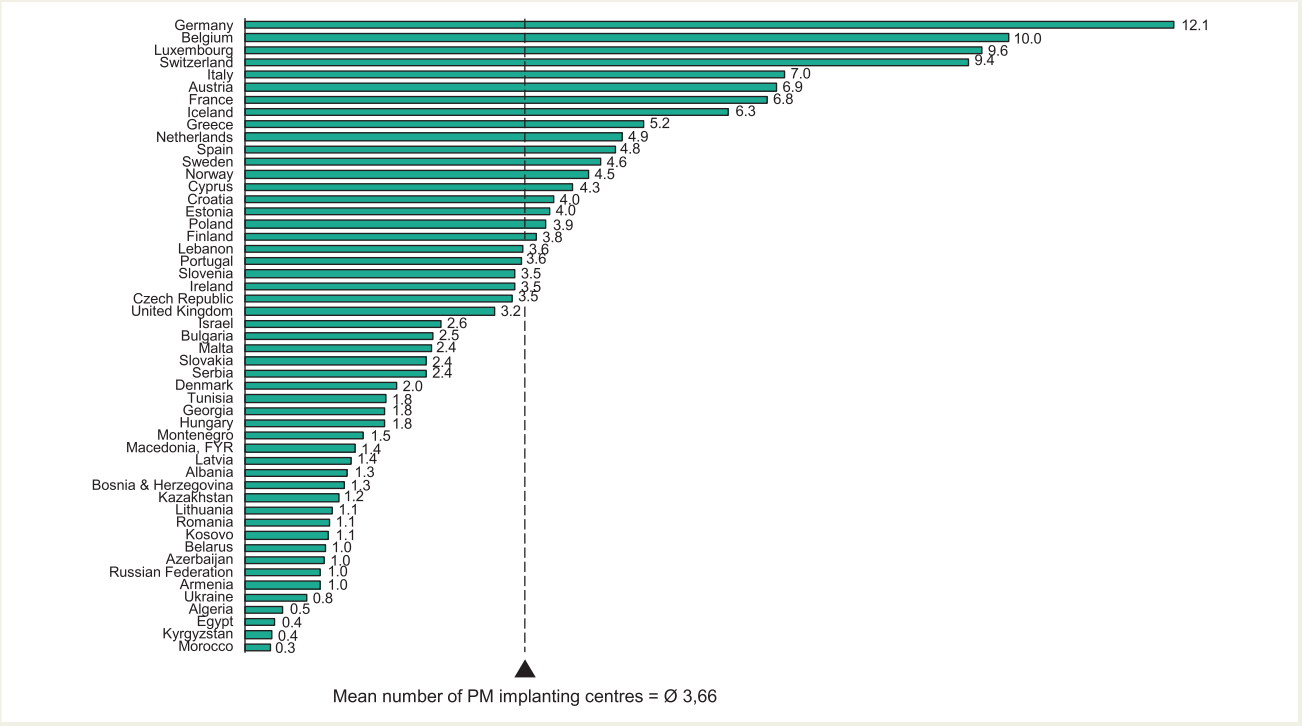

Figure 10 Number of PM implanting centres per million inhabitants in the ESC countries in 2014. The mean number of implantation centres is weighted by population.

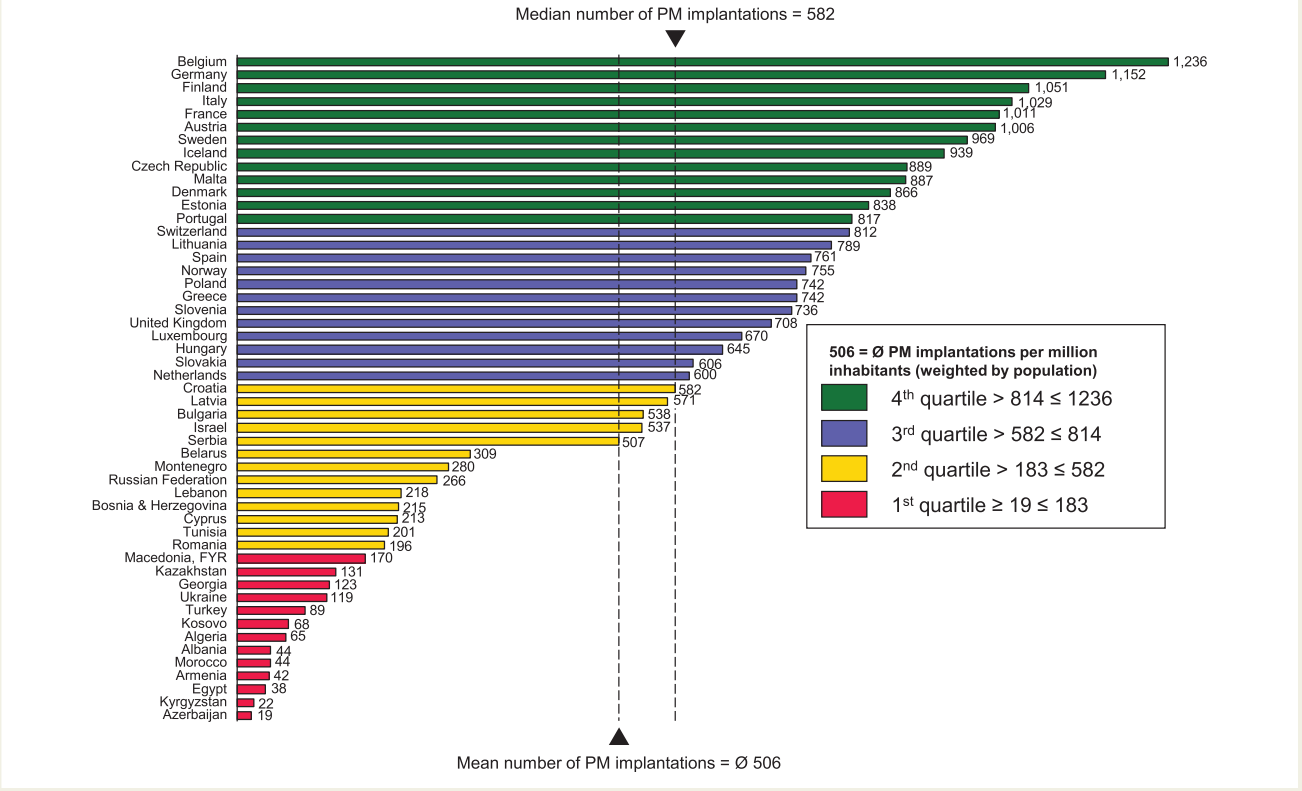

Figure 11 Pacemaker implantations per million inhabitants in the ESC countries in 2014. The mean number of implantations is weighted by population.

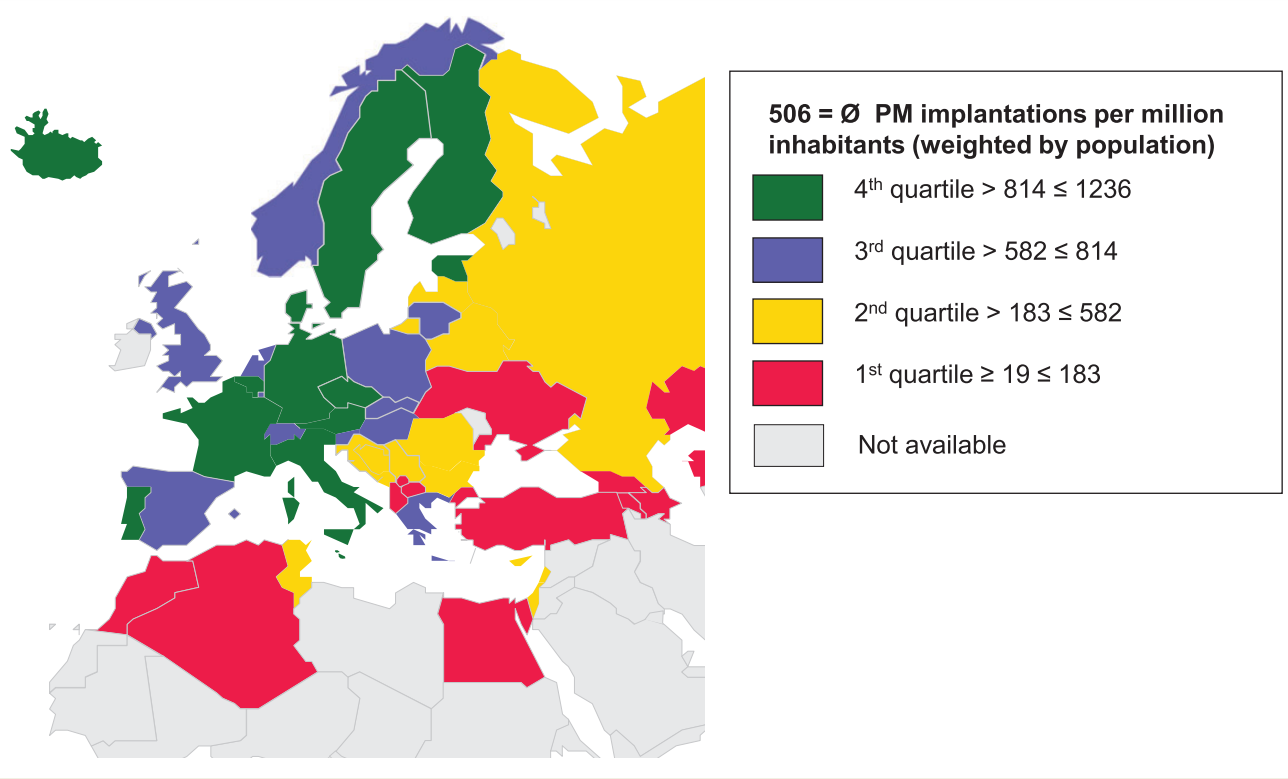

Figure 12 Pacemaker implantations per million inhabitants in the ESC countries in 2014. The mean number of implantations is weighted by population.

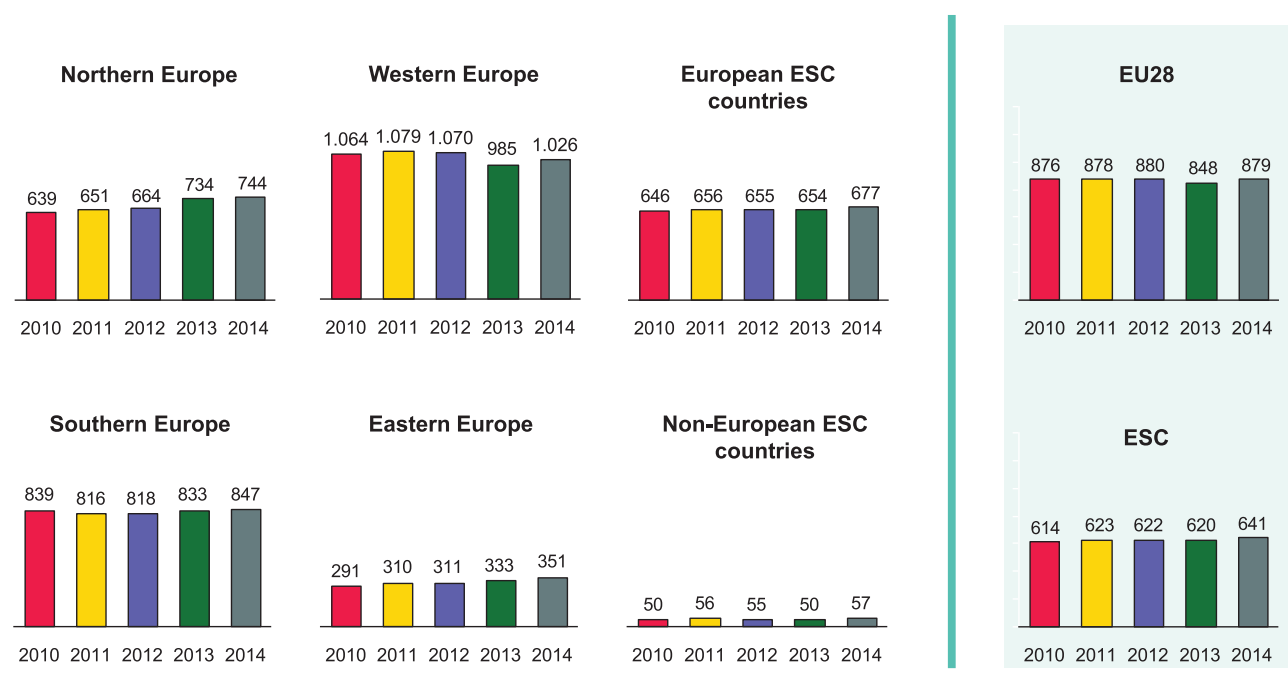

Figure 13 Pacemaker implantations per million inhabitants 2010–14 in the five geographical regions of the ESC and comparison to the total ESC area and the 28 member countries of the European Union (EU28).

Figure 14 Pacemaker implantations per million inhabitants 2010–14 in Northern Europe. *No data available.

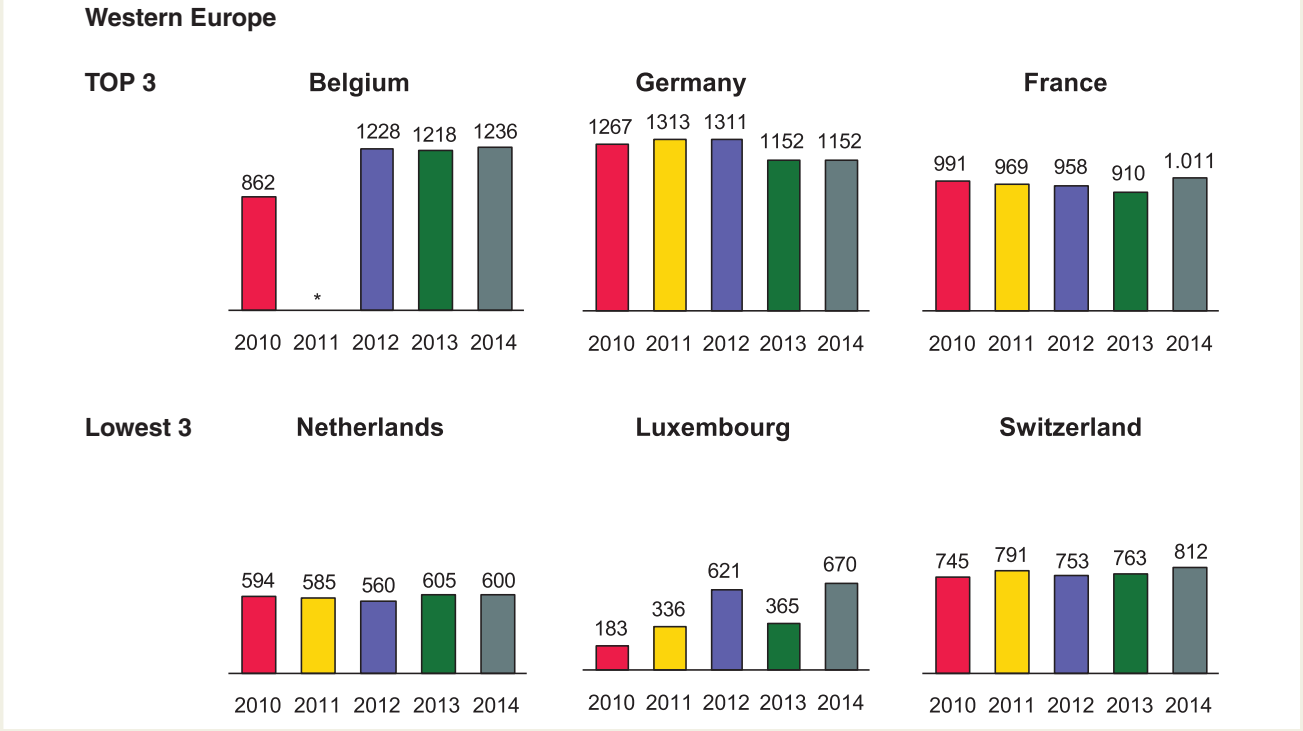

Figure 15 Pacemaker implantations per million inhabitants 2010–14 in Western Europe. *No data available.

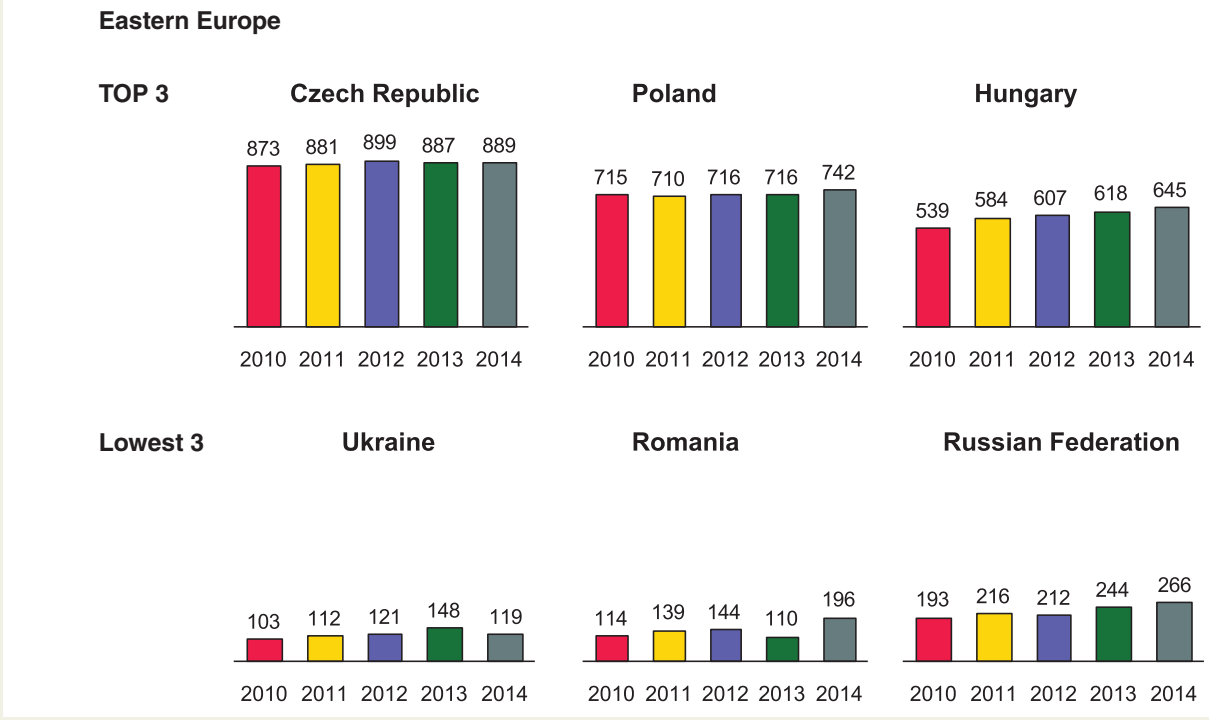

Figure 16 Pacemaker implantations per million inhabitants 2010–14 in Eastern Europe.

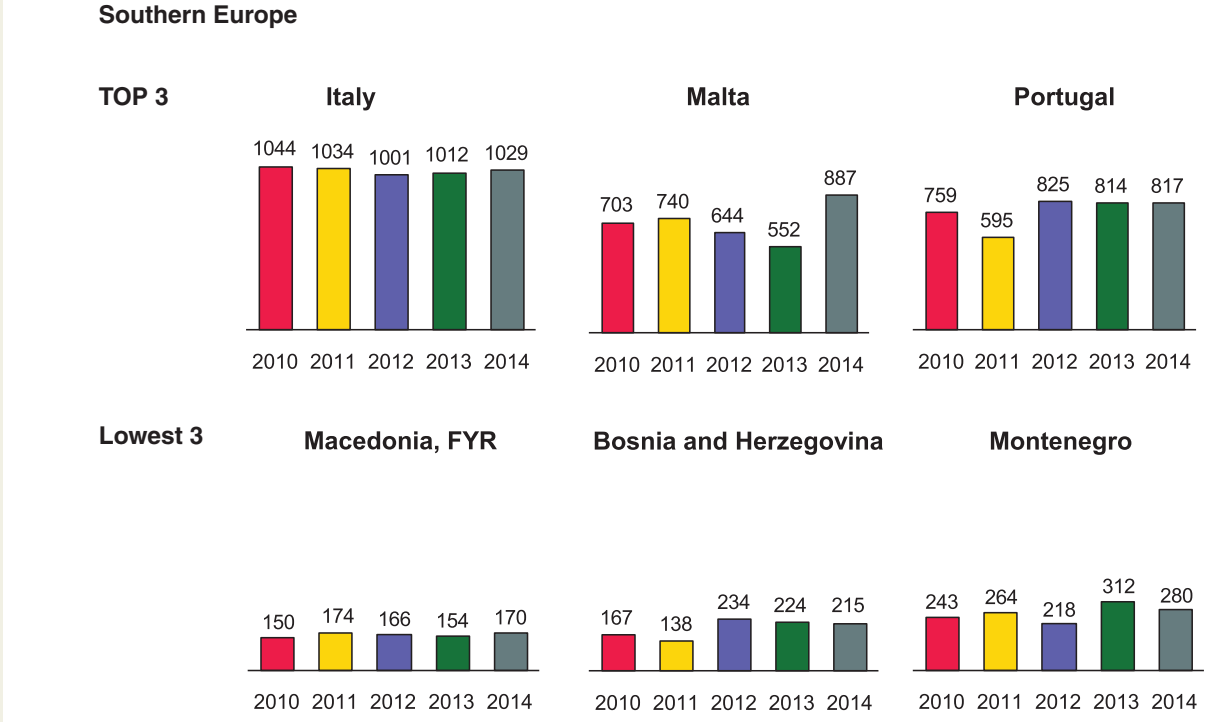

Figure 17 Pacemaker implantations per million inhabitants 2010–14 in Southern Europe.

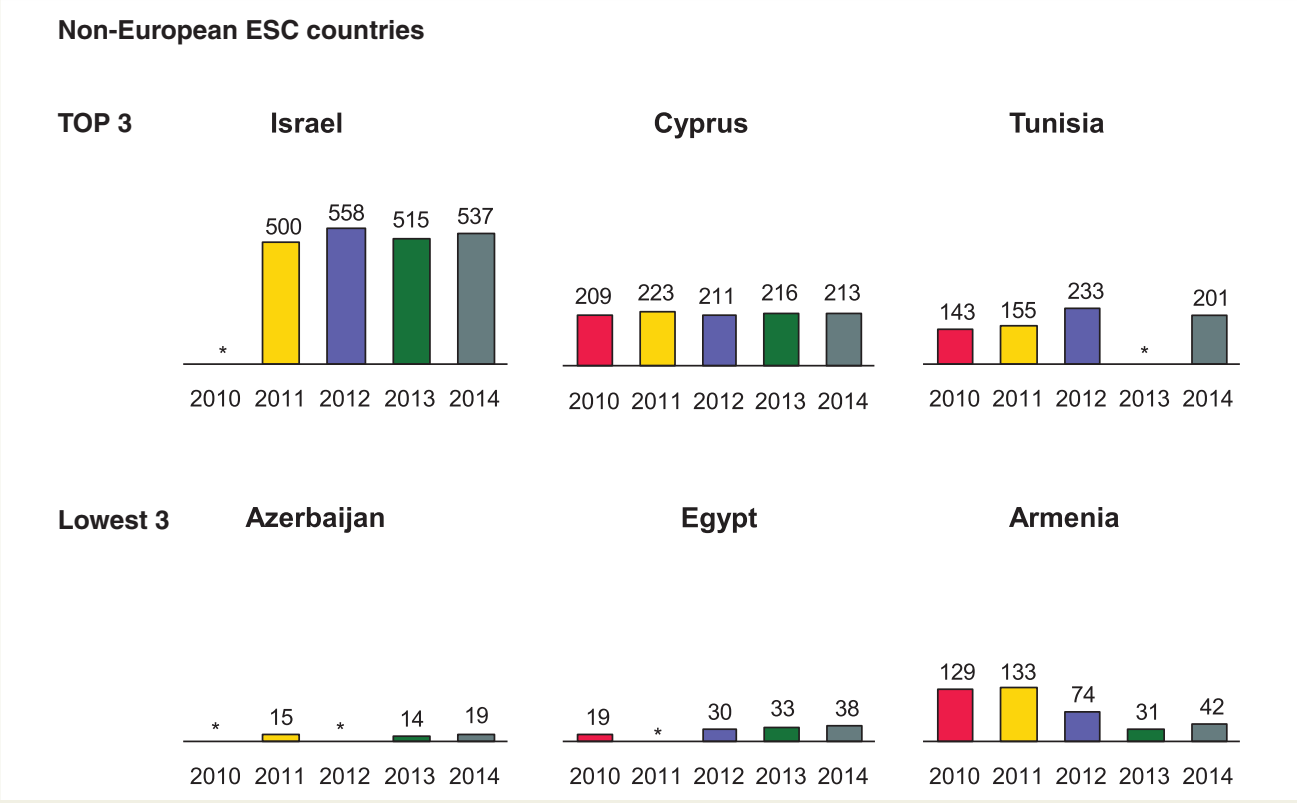

Figure 18 Pacemaker implantations per million inhabitants 2010–14 in the non-European ESC countries. *No data available.

The number of ICD implantations according to the five ESC regions and the trend from 2009 to 2013, compared with the EU28 and the whole ESC area, are shown in *Figure 27*. In Western Europe (255), the number of ICD implantations per million inhabitants was almost twice as high as in any other ESC region. Implantable cardioverter-defibrillator implantation rate also exceed 100 per million population in the Southern (139) and Northern (119) European regions. The top and bottom three countries within the five ESC region are shown in *Figures 28–32*. The most active countries in each region were Germany (295 per million inhabitants), Finland and Norway (both 220), Poland (219), Italy (223), and Israel (215).

The change in the number of implanting centres from 2013 to 2014 is shown in *Table 9* and *Figure 33*, and the change in the number of ICD implantations per million inhabitants during the same period is presented in *Table 10* and *Figure 34*. These numbers are divided into *de novo* implantations and ICD generator replacements in *Figures 35* and *36*. The increase in ICD implantations per million inhabitants was greatest in Kazakhstan. Georgia, Romania, Algeria, and Azerbaijan also reported a more than 50% increase in ICD implantations. On the other hand, four countries (Malta, the Czech Republic, Ukraine, and Morocco) reported a more than 20% drop in the ICD implantation rate per million population (*Table 10* and *Figure 34*).

The relationship between the annual ICD implantation rate per million inhabitants and the number of ICD implanting centres per million inhabitants in the EU28 countries and the ESC area is shown in *Figure 37*.

Cardiac resynchronization therapy devices

General information

The 51 countries which submitted data on cardiac resynchronization therapy (CRT) for the EHRA White Book 2015 are listed in *Table 11*. Ireland, Libya, San Marino, Moldova, and Syria did not report any data related to CRT therapy. The vast majority of implants was performed by cardiologists (*Table 5*), and the remaining implantations were performed by physicians having various other training backgrounds, mainly surgeons. In Ukraine, however, all implants were done by surgeons (*Table 5*).

Cardiac resynchronization therapy facilities and procedure rates

It was reported that in 2014, a total of 78 123 CRT devices were implanted in 1978 national centres (*Table 11*). There was an increase in both absolute numbers of implants and the rate of implants per million inhabitants compared with 2013 (*Table 11*). The absence of the French data in 2013 was likely a factor in this respect. The number of CRT implanting centres per million inhabitants in the ESC countries is shown in *Figure 38*. The mean number of implanting centres was 2.05 per country, which is a slight increase from the previous year. Germany (8.27), Italy (6.13), and Switzerland (5.95) had the highest density of centres implanting CRT devices.

Table 6 Changes in the number of PM implantation centres in year 2013 vs. 2014

Country	ISO code	Number of PM implanting centres 2013		Number of PM implanting centres 2014		Change %
		Absolute number	Per mil inhabitants	Absolute number	Per mil inhabitants	
Albania	AL	N/A	N/A	4	1.32	N/A
Algeria	DZ	19	0.50	19	0.49	−1.9
Armenia	AM	2	0.65	3	0.98	50.2
Austria	AT	57	6.93	57	6.93	0.0
Azerbaijan	AZ	6	0.63	10	1.03	65.0
Belarus	BY	10	1.04	10	1.04	0.2
Belgium	BE	105	10.05	104	9.95	−1.0
Bosnia & Herzegovina	BA	6	1.55	5	1.29	−16.6
Bulgaria	BG	17	2.43	17	2.45	0.8
Croatia	HR	18	4.02	18	4.03	0.1
Cyprus	CY	5	4.33	5	4.26	−1.5
Czech Republic	CZ	37	3.49	37	3.48	−0.2
Denmark	DK	11	1.98	11	1.98	−0.2
Egypt	EG	28	0.33	33	0.38	15.7
Estonia	EE	5	3.95	5	3.97	0.7
Finland	FI	20	3.80	20	3.80	−0.1
France	FR	500	7.58	451	6.81	−10.2
Georgia	GE	9	1.82	9	1.82	0.1
Germany	DE	1010	12.45	980	12.10	−2.8
Greece	GR	56	5.20	56	5.20	0.0
Hungary	HU	17	1.71	18	1.81	6.1
Iceland	IS	2	6.34	2	6.30	−0.7
Ireland	IE	17	3.56	17	3.52	−1.2
Israel	IL	20	2.60	20	2.56	−1.5
Italy	IT	420	6.83	433	7.02	2.8
Kazakhstan	KZ	27	1.52	22	1.23	−19.5
Kosovo	XK	N/A	N/A	2	1.08	N/A
Kyrgyzstan	KGZ	N/A	N/A	2	0.36	N/A
Latvia	LV	3	1.38	3	1.39	0.6
Lebanon	LB	15	3.63	15	3.63	−0.1
Libya[a]	LY	N/A	N/A	N/A	N/A	N/A
Lithuania	LT	4	1.14	4	1.14	0.3
Luxembourg	LU	5	9.71	5	9.60	−1.1
Macedonia, FYR	MK	2	0.96	3	1.43	49.7
Malta	MT	2	4.86	1	2.42	−50.2
Moldova[a]	MD	1	0.28	N/A	N/A	N/A
Montenegro	ME	1	1.53	1	1.54	0.5
Morocco	MA	11	0.34	11	0.33	−2.5
Netherlands	NL	90	5.36	83	4.92	−8.2
Norway	NO	23	4.52	23	4.47	−1.2
Poland	PL	145	3.78	150	3.91	3.5
Portugal	PT	40	3.70	39	3.61	−2.6
Romania	RO	22	1.01	24	1.10	9.4
Russian Federation	RU	140	0.98	140	0.98	0.0
San Marino[a]	SM	1	30.82	N/A	N/A	N/A
Serbia	RS	18	2.49	17	2.36	−5.1
Slovakia	SK	14	2.55	13	2.37	−7.2
Slovenia	SI	8	4.01	7	3.52	−12.3
Spain	ES	230	4.86	230	4.82	−0.8
Sweden	SE	42	4.35	45	4.63	6.3
Switzerland	CH	76	9.50	76	9.43	−0.8
Syria[a]	SY	N/A	N/A	N/A	N/A	N/A
Tunisia	TN	N/A	N/A	20	1.83	N/A
Turkey	TR	N/A	N/A	N/A	N/A	N/A
Ukraine	UA	36	0.81	36	0.81	0.6
United Kingdom	GB	227	3.58	207	3.25	−9.3

[a]These four countries did not submit data for the EHRA White Book 2015.

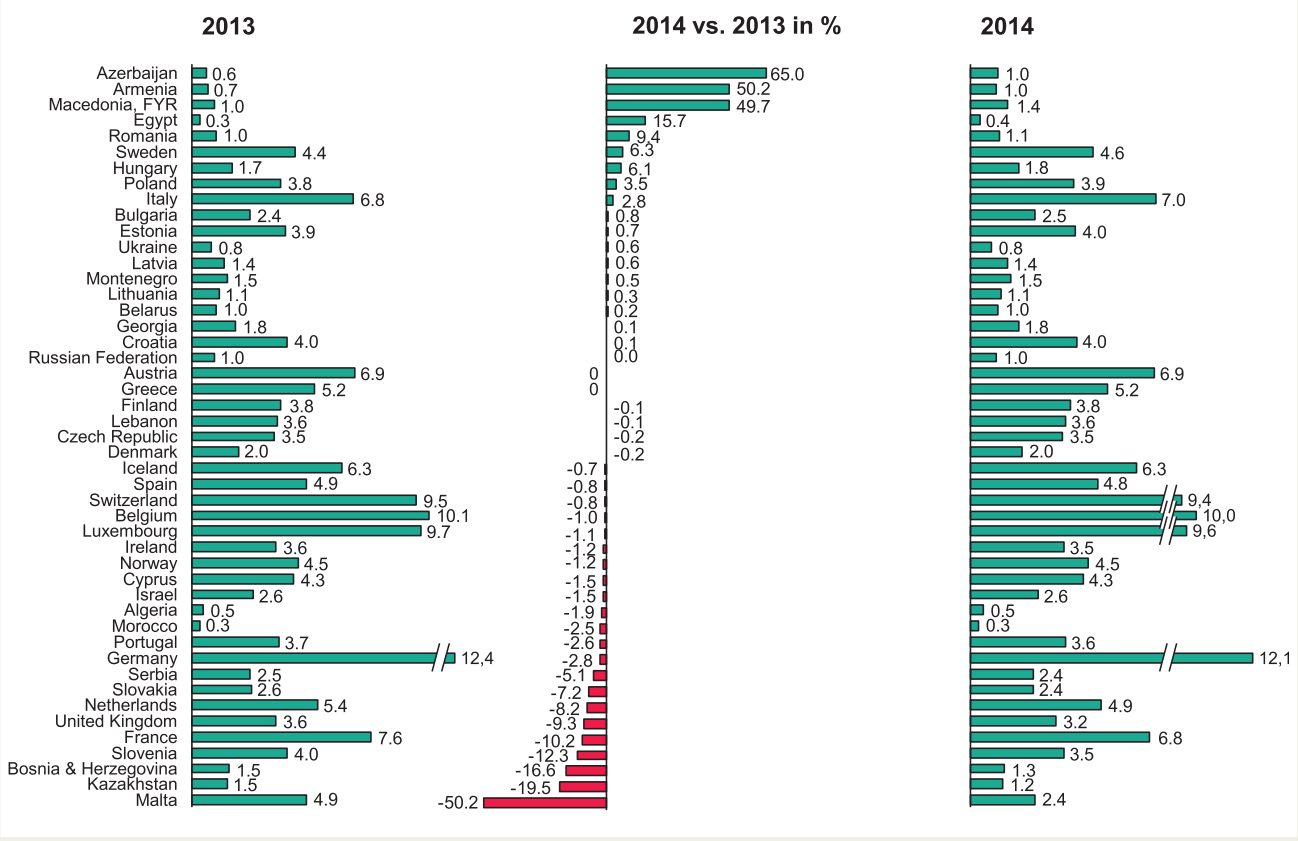

Figure 19 Change in the number of PM implanting centres per million inhabitants 2013–14.

Implantation rates with the countries divided into quartiles are shown as a bar graph in *Figure 39* and as a geographical map in *Figure 40*. *Figures 41* and *42* show the corresponding numbers for CRT pacemakers (CRT-Ps) and CRT defibrillators (CRT-Ds). The ratio of CRT-D/CRT-P implants was 2.67 with a mean of 56 CRT-Ds and 21 CRT-Ps per million inhabitants. Cardiac resynchronization therapy defibrillator implantation rate was highest in Germany (201 per million inhabitants) followed by Italy (166), Israel (160), and the Czech Republic (137). Denmark had the highest rate of CRT-P implantations (75 per million inhabitants) followed by the United Kingdom, France, and Austria (*Figure 41* and *42*).

The distribution of CRT implantations within the five geographical ESC regions is shown in *Figure 43* and further data within each region are shown in *Figures 44–48*. The most active countries within each region were Germany (242 per million inhabitants), Denmark (173), the Czech Republic (176), Italy (200), and Israel (170).

The changes in the number of implanting centres per million inhabitants between 2013 and 2014 are shown in *Table 12* and *Figure 49*. The changes between 2013 and 2014 in the number of total CRT implantations are shown in *Table 13* and *Figure 50*, and the change according to CRT device type is shown in *Figures 51* and *52*. By far the highest growth rate in CRT device implantations per million was in Malta, with a reported almost 200% increase between the last 2 years. Montenegro (121.2%) and Iceland (84.5%) both reported significant increases in the number of CRT device implantations. In contrast, the number of CRT implantations decreased by 60% in Armenia and by 26.7% in Estonia.

The relationship between the annual CRT implantation rate and the number of CRT implanting centres per million population in the EU28 countries and the ESC area is shown in *Figure 53*.

Lead extraction

General information

This was the third year that information on lead extractions (LEs) was included in the EHRA White Book. The number of countries submitting data on LE procedures increased from 30 in 2013 to 43 in 2014 (*Table 14*), but some countries submitted incomplete data and 13 countries did not give any information on LE. For example, Denmark gave the number of LE centres but not the number of the procedures. In most countries, the primary operator in LE procedures was a cardiologist.

Lead extraction facilities and procedure rates

A total of 10 482 LE procedures (*Table 14*) were performed in 764 LE centres in 2014. The density of the LE centres (6.9 per million inhabitants) was highest in Germany (*Figure 54*). Six countries had no LE centres (Armenia, Bosnia & Herzegovina, Bulgaria, Kazakhstan, Kosovo, and Montenegro). It has been proposed that in an

Table 7 Changes in the number of PM implantations in year 2013 vs. 2014

Country	ISO code	Number of PM implantations 2013		Number of PM implantations 2014		Change %
		Absolute number	Per mil inhabitants	Absolute number	Per mil inhabitants	
Albania	AL	N/A	N/A	134	44	N/A
Algeria	DZ	2480	65	2508	65	−0.8
Armenia	AM	94	31	129	42	37.4
Austria	AT	7950	967	8272	1006	4.0
Azerbaijan	AZ	131	14	184	19	39.1
Belarus	BY	2813	292	2970	309	5.8
Belgium	BE	12 725	1218	12 912	1236	1.4
Bosnia & Herzegovina	BA	868	224	831	215	−4.2
Bulgaria	BG	3511	503	3726	538	7.0
Croatia	HR	2418	540	2601	582	7.7
Cyprus	CY	250	216	250	213	−1.5
Czech Republic	CZ	9416	887	9447	889	0.2
Denmark	DK	4725	850	4823	866	1.8
Egypt	EG	2850	33	3320	38	14.3
Estonia	EE	1155	912	1054	838	−8.1
Finland	FI	5369	1020	5536	1051	3.1
France	FR	60 000	910	67 000	1011	11.1
Georgia	GE	620	125	608	123	−1.8
Germany	DE	93 520	1152	93 315	1152	0.0
Greece	GR	7800	724	8000	742	2.5
Hungary	HU	6143	618	6393	645	4.3
Iceland	IS	314	996	298	939	−5.7
Ireland	IE	2288	479	N/A	N/A	N/A
Israel	IL	3966	515	4200	537	4.3
Italy	IT	62 198	1012	63 442	1029	1.7
Kazakhstan	KZ	1489	84	2355	131	56.3
Kosovo	XK	N/A	N/A	127	68	N/A
Kyrgyzstan	KGZ	N/A	N/A	126	22	N/A
Latvia	LV	1288	591	1236	571	−3.4
Lebanon	LB	900	218	900	218	−0.1
Libya[a]	LY	N/A	N/A	N/A	N/A	N/A
Lithuania	LT	2716	772	2767	789	2.2
Luxembourg	LU	188	365	349	670	83.6
Macedonia, FYR	MK	322	154	356	170	10.3
Malta	MT	227	552	366	887	60.7
Moldova[a]	MD	287	79	N/A	N/A	N/A
Montenegro	ME	204	312	182	280	−10.3
Morocco	MA	1109	34	1465	44	28.8
Netherlands	NL	10 174	605	10 132	600	−0.8
Norway	NO	3459	680	3887	755	11.0
Poland	PL	27 500	716	28 470	742	3.6
Portugal	PT	8790	814	8830	817	0.3
Romania	RO	2400	110	4258	196	77.9
Russian Federation	RU	34 758	244	37 832	266	8.9
San Marino[a]	SM	14	431	N/A	N/A	N/A
Serbia	RS	3958	546	3657	507	−7.2
Slovakia	SK	3456	630	3326	606	−3.8
Slovenia	SI	1287	646	1464	736	14.0
Spain	ES	35 500	749	36 322	761	1.5
Sweden	SE	9602	995	9421	969	−2.7
Switzerland	CH	6097	763	6543	812	6.4
Syria[a]	SY	N/A	N/A	N/A	N/A	N/A
Tunisia	TN	N/A	N/A	2200	201	N/A
Turkey	TR	N/A	N/A	7300	89	N/A
Ukraine	UA	6579	148	5258	119	−19.6
United Kingdom	GB	44 503	702	45 131	708	0.9

[a]These four countries did not submit data for the EHRA White Book 2015.

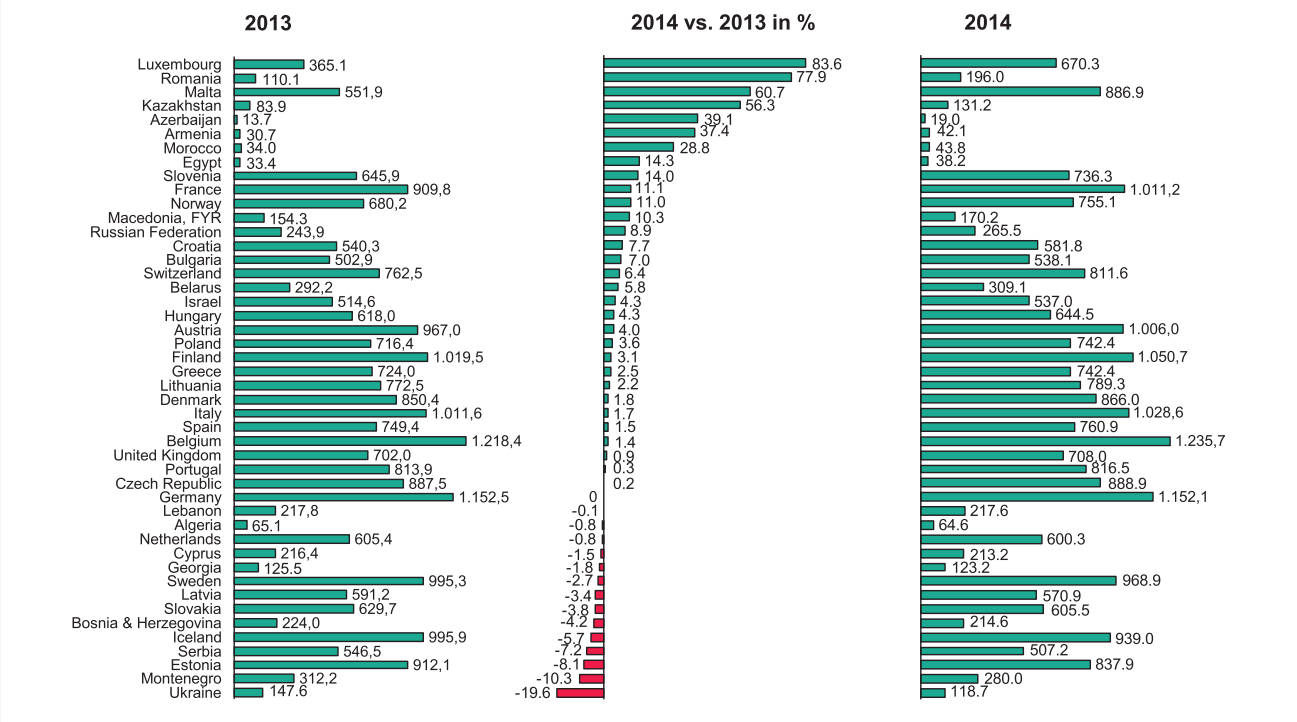

Figure 20 Change in the number of PM implantations per million inhabitants 2013–14.

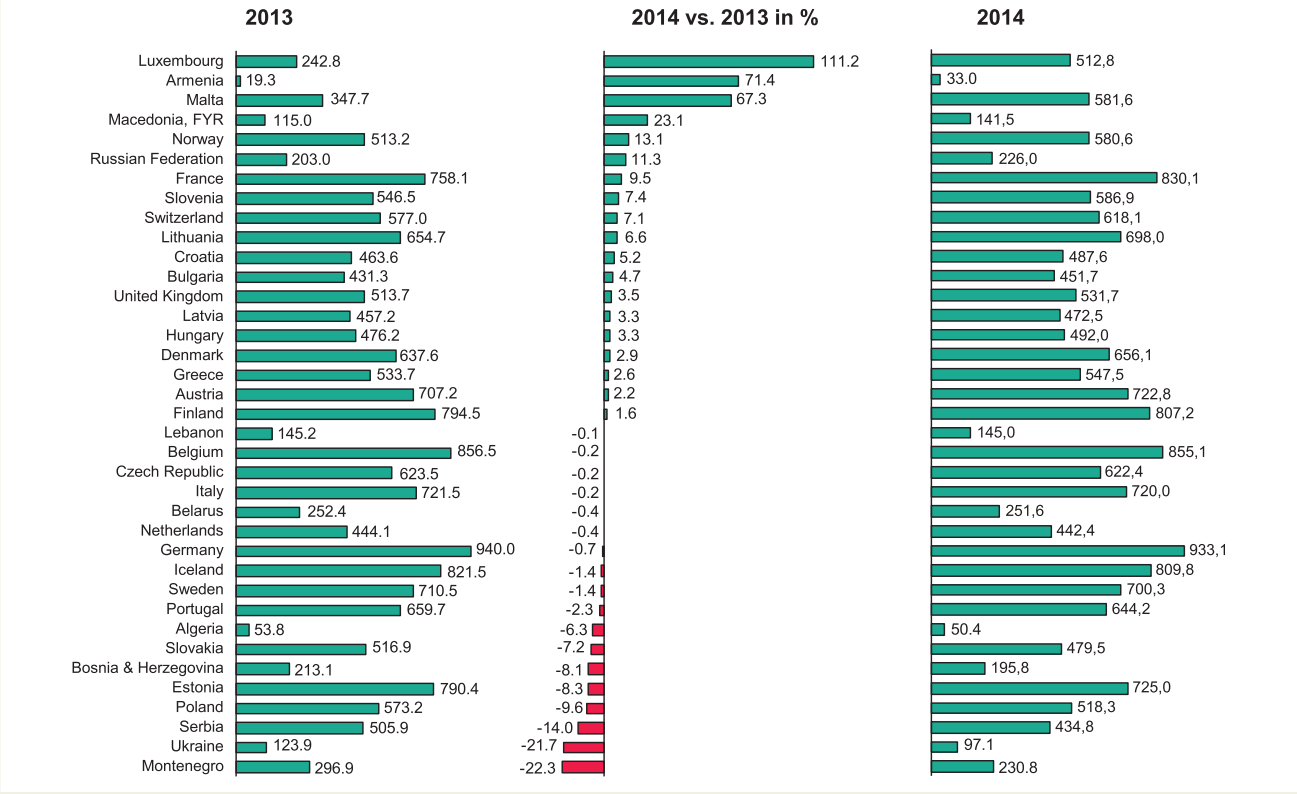

Figure 21 Change in the number of new PM implantations per million inhabitants 2013–14.

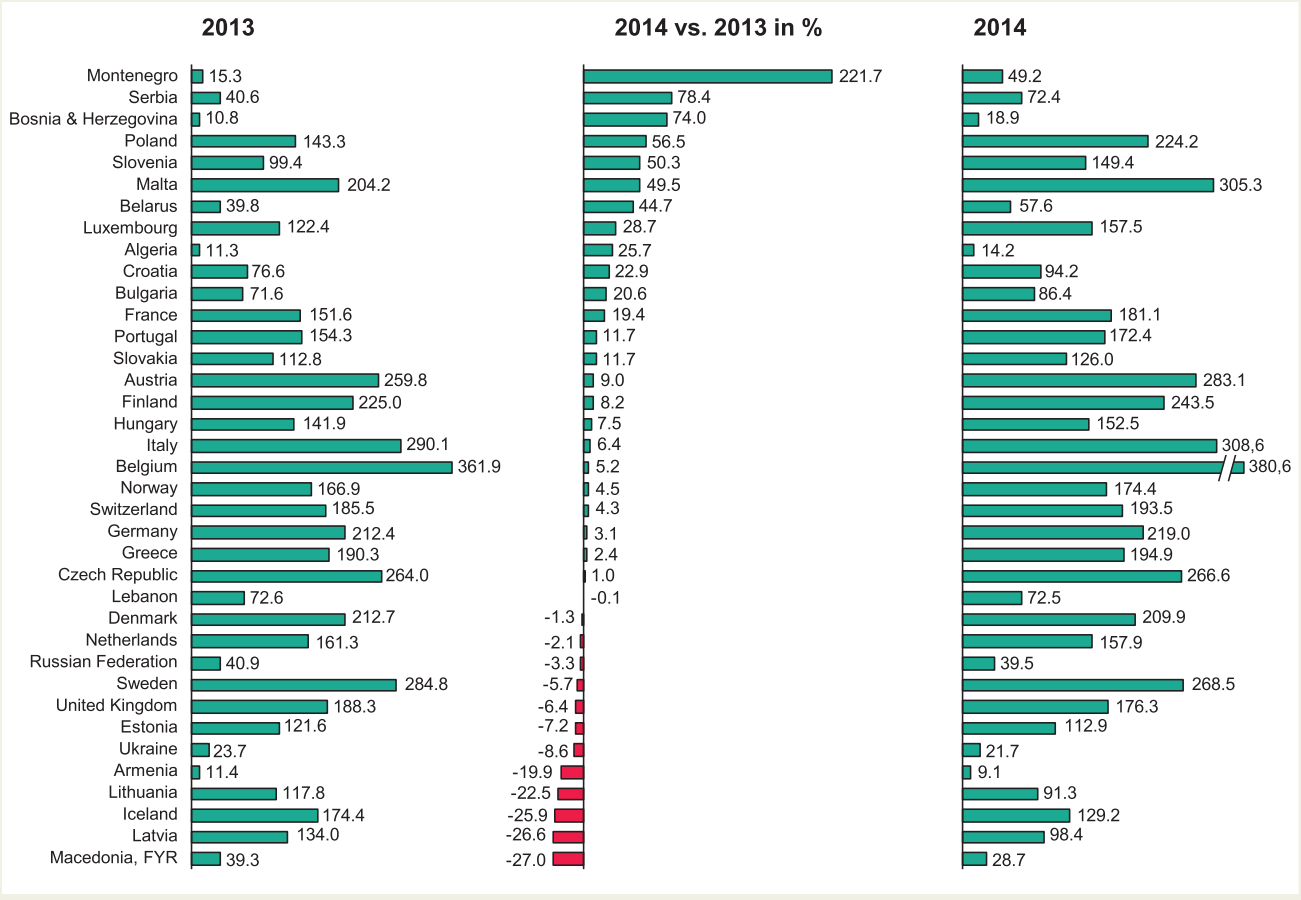

Figure 22 Change in the number of PM replacements per million inhabitants 2013–14.

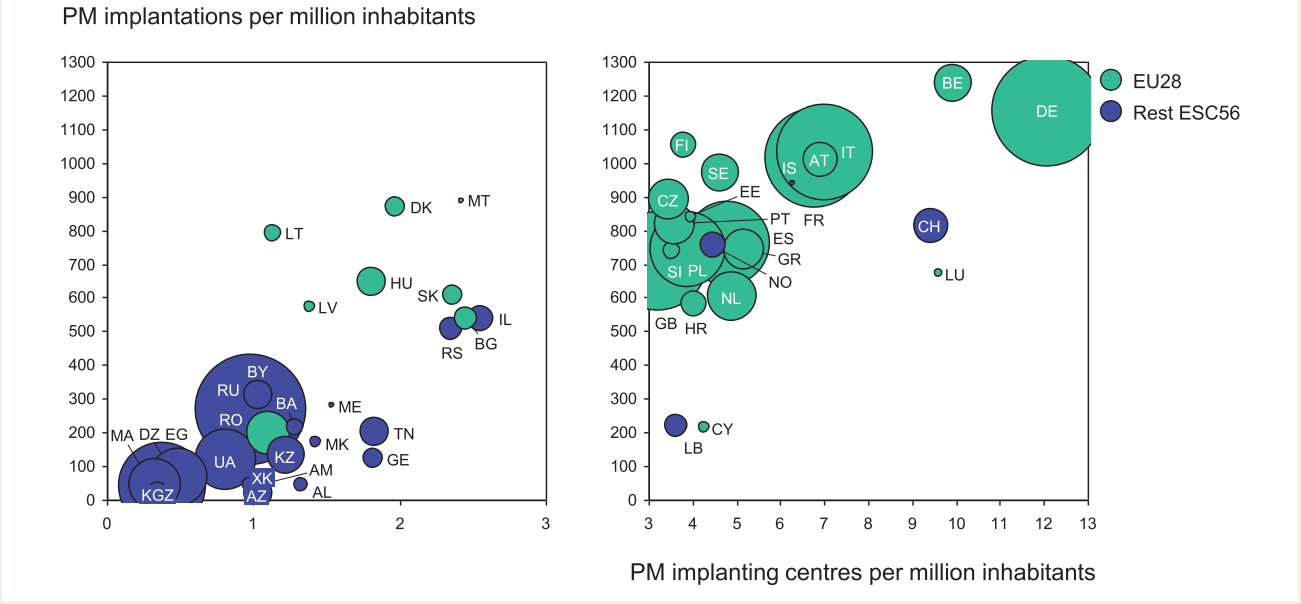

Figure 23 Pacemaker implantation centres and rates in the ESC and European Union (EU28) member countries in 2014. Bubble size is related to population in the country. The ISO codes of the countries are explained in *Table 1*.

Table 8 Implantable cardioverter-defibrillator implantation facilities and rates in 2014 and comparison to four previous years

Country	ISO code	National registry for ICD implants	Number of ICD implanting centres 2014		ICD implantations 2014		Development potential—target number of ICD implantations		ICD implantations per mil inhabitants				
			Absolute number	Per mil inhabitants	Absolute number	Per mil inhabitants	To attain mean ESC area level	To attain mean EU28 level	2010	2011	2012	2013	2014
Albania	AL	No	2	0.66	4	1	306	543	N/A	N/A	N/A	N/A	1
Algeria	DZ	No	8	0.21	60	2	3933	6973	N/A	N/A	N/A	1	2
Armenia	AM	No	3	0.98	25	8	310	550	11	12	N/A	9	8
Austria	AT	Yes	21	2.55	1362	166	–	1477	154	220	145	158	166
Azerbaijan	AZ	No	7	0.72	20	2	981	1740	2	2	N/A	1	2
Belarus	BY	Yes	10	1.04	172	18	974	1726	6	14	12	16	18
Belgium	BE	Yes	23	2.20	1611	154	–	1877	194	197	210	163	154
Bosnia & Herzegovina	BA	No	5	1.29	55	14	392	696	7	13	14	17	14
Bulgaria	BG	Yes	9	1.30	47	7	702	1244	2	8	7	5	7
Croatia	HR	No	12	2.68	173	39	453	803	18	19	26	35	39
Cyprus	CY	No	4	3.41	73	62	119	211	44	58	46	52	62
Czech Republic	CZ	Yes	17	1.60	2138	201	–	–	258	270	277	301	201
Denmark	DK	Yes	6	1.08	1208	217	–	–	195	198	218	231	217
Egypt	EG	No	16	0.18	236	3	8805	15 611	1	N/A	2	2	3
Estonia	EE	No	2	1.59	96	76	127	226	40	45	79	82	76
Finland	FI	No	19	3.61	1161	220	–	–	154	134	166	194	220
France	FR	No	162	2.44	13 700	207	–	–	91	102	106	N/A	207
Georgia	GE	No	8	1.62	104	21	500	887	3	5	12	12	21
Germany	DE	No	670	8.27	23 898	295	–	–	307	326	326	336	295
Greece	GR	No	24	2.23	1080	100	1092	1936	90	83	87	97	100
Hungary	HU	Yes	13	1.31	956	96	1005	1782	72	80	85	95	96
Iceland	IS	No	1	3.15	59	186	–	–	81	113	134	171	186
Ireland	IE	Yes	17	3.52	N/A	N/A	N/A	N/A	130	140	144	153	N/A
Israel	IL	Yes	20	2.56	1685	215	–	–	180	156	137	166	215
Italy	IT	Yes	397	6.44	13 729	223	–	–	183	196	196	204	223
Kazakhstan	KZ	No	15	0.84	402	22	1819	3225	N/A	N/A	7	12	22
Kosovo	XK	No	1	0.54	3	2	188	334	N/A	N/A	N/A	N/A	2
Kyrgyzstan	KGZ	N/A	0	0.00	0	0	568	1007	N/A	N/A	N/A	N/A	N/A

Latvia	LV	Yes	3	1.39	75	35	219	389	21	29	32	40	35
Lebanon	LB	No	15	3.63	300	73	419	743	N/A	N/A	N/A	73	73
Libya[a]	LY	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Lithuania	LT	No	3	0.86	134	38	355	630	25	33	42	35	38
Luxembourg	LU	Yes	1	1.92	62	119	–	94	74	99	149	138	119
Macedonia, FYR	MK	Yes	2	0.96	11	5	42	74	7	13	7	6	5
Malta	MT	No	1	2.42	36	87	66	117	74	71	132	163	87
Moldova[a]	MD	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	N/A
Montenegro	ME	No	1	1.54	41	63	1710	3032	27	47	44	58	63
Morocco	MA	Yes	7	0.21	27	1	522	925	1	1	1	1	1
Netherlands	NL	Yes	28	1.66	3577	212	–	–	169	155	160	244	212
Norway	NO	Yes	11	2.14	1134	220	–	–	130	184	199	214	220
Poland	PL	No	120	3.13	8399	219	–	–	183	157	182	234	219
Portugal	PT	Yes	31	2.87	N/A	N/A	N/A	N/A	75	95	92	N/A	N/A
Romania	RO	No	15	0.69	332	15	14 436	25 596	8	8	8	9	15
Russian Federation	RU	Yes	55	0.39	1769	12	3	6	4	10	11	13	12
San Marino[a]	SM	N/A	N/A	N/A	N/A	N/A	N/A	N/A	635	597	404	616	N/A
Serbia	RS	Yes	10	1.39	457	63	557	987	38	44	38	62	63
Slovakia	SK	Yes	4	0.73	658	120	–	357	90	100	105	108	120
Slovenia	SI	Yes	2	1.01	174	88	4837	8576	50	72	61	71	88
Spain	ES	Yes	112	2.35	3869	81	985	1747	70	74	73	82	81
Sweden	SE	Yes	35	3.60	2097	216	–	–	118	N/A	193	198	216
Switzerland	CH	Yes	52	6.45	1341	166	–	4060	205	142	195	201	166
Syria[a]	SY	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tunisia	TN	No	8	0.73	140	13	1108	1965	8	8	9	N/A	13
Turkey	TR	No	N/A	N/A	6300	77	8270	14 663	N/A	N/A	N/A	N/A	77
Ukraine	UA	No	8	0.18	57	1	4488	7957	1	1	1	2	1
United Kingdom	GB	Yes	126	1.98	6474	102	–	11 452	83	86	91	92	102
Total ESC countries	56		2142		101 521								

[a]These four countries did not submit data for the EHRA White Book 2015.

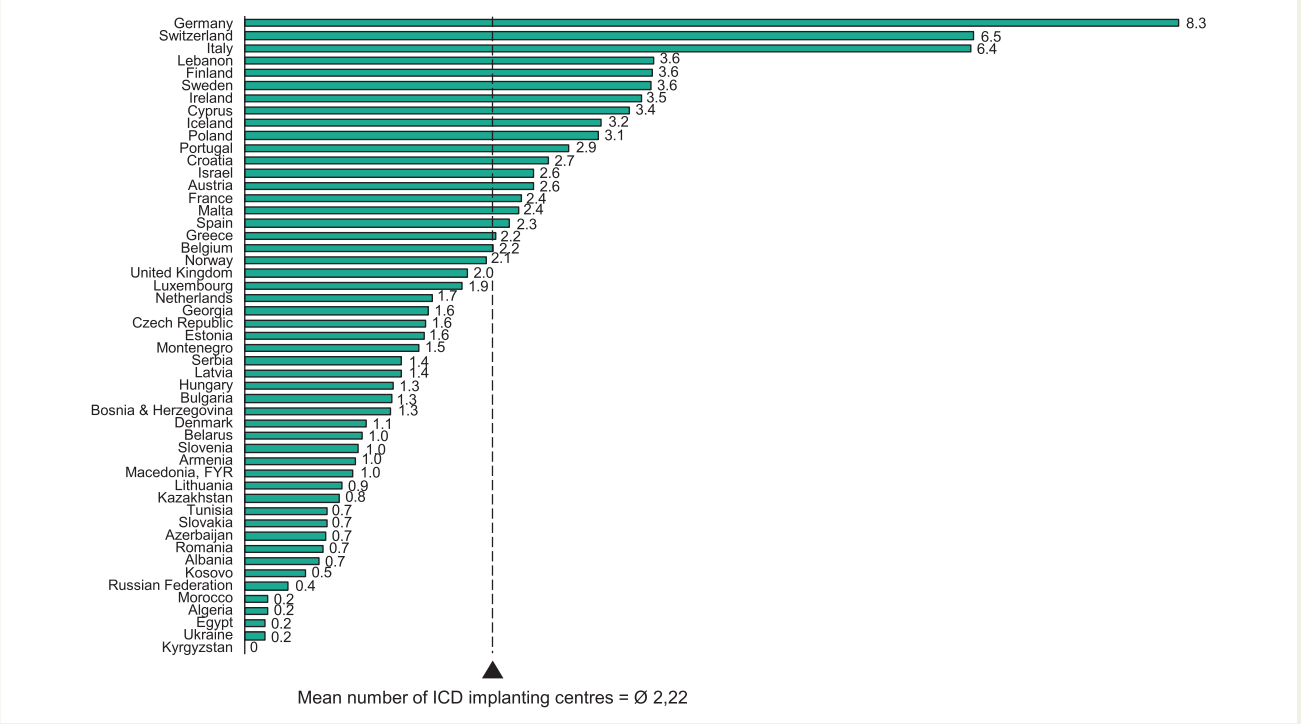

Figure 24 Implantable cardioverter-defibrillator implanting centres per million inhabitants in 2014. The mean number of implantation centres is weighted by population.

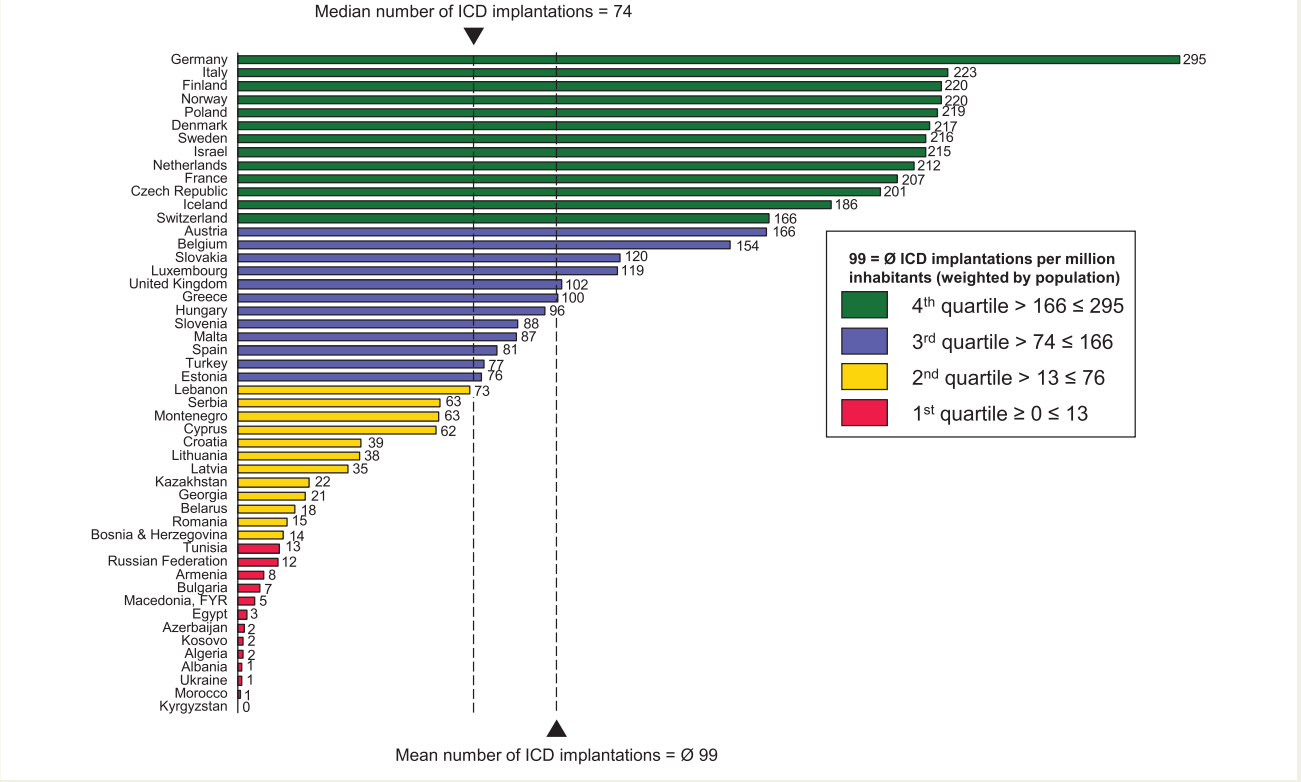

Figure 25 Implantable cardioverter-defibrillator implantations per million inhabitants in 2014. The mean number of implantations is weighted by population.

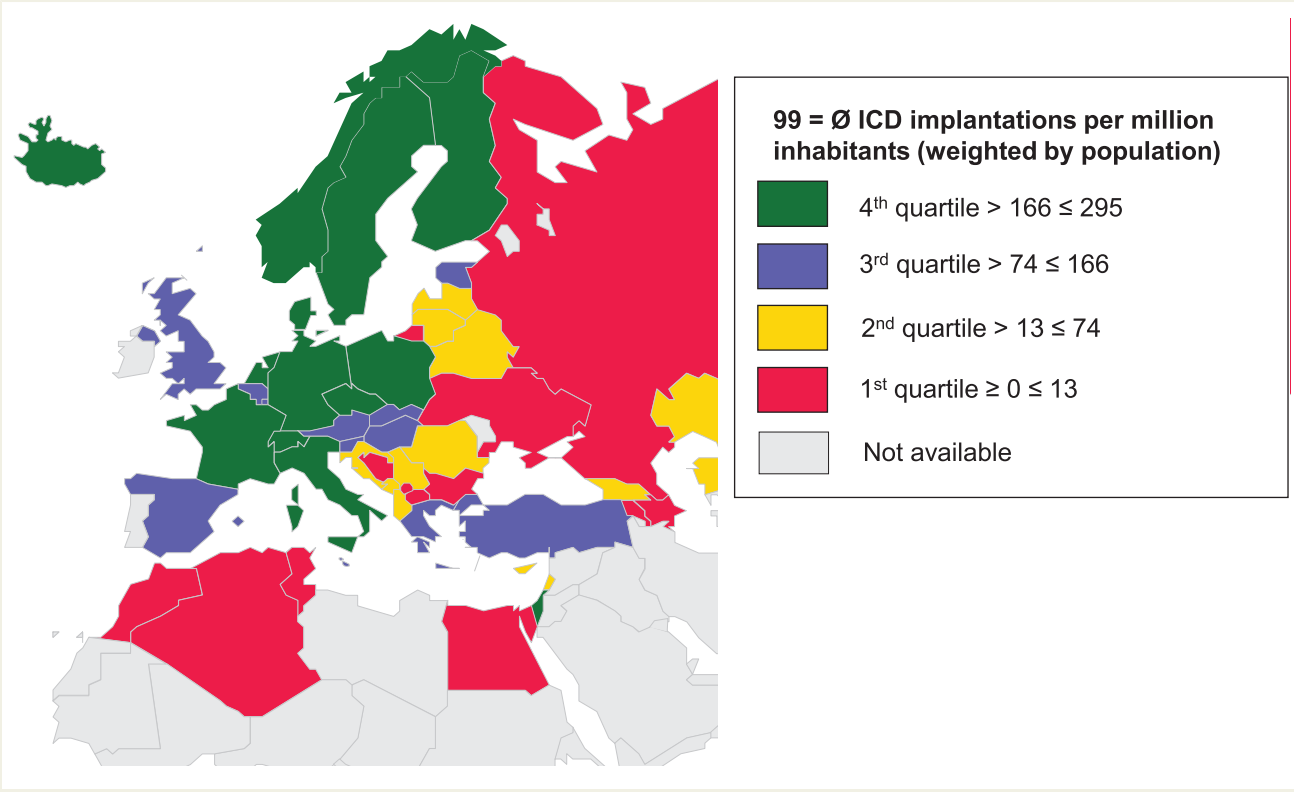

Figure 26 Implantable cardioverter-defibrillator implantations per million inhabitants in the ESC countries in 2014.

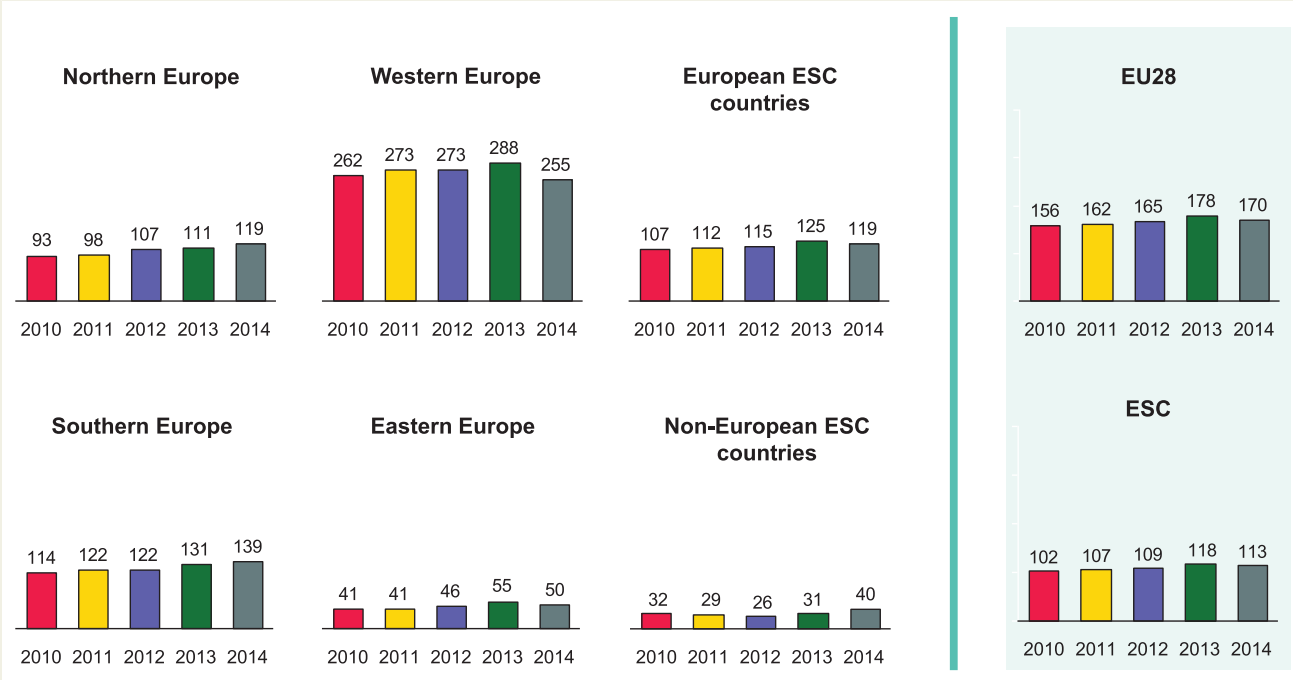

Figure 27 Implantable cardioverter-defibrillator implantations per million inhabitants 2010–14 in the five geographical regions of the ESC and comparison to the total ESC area and the 28 member countries of the European Union (EU28).

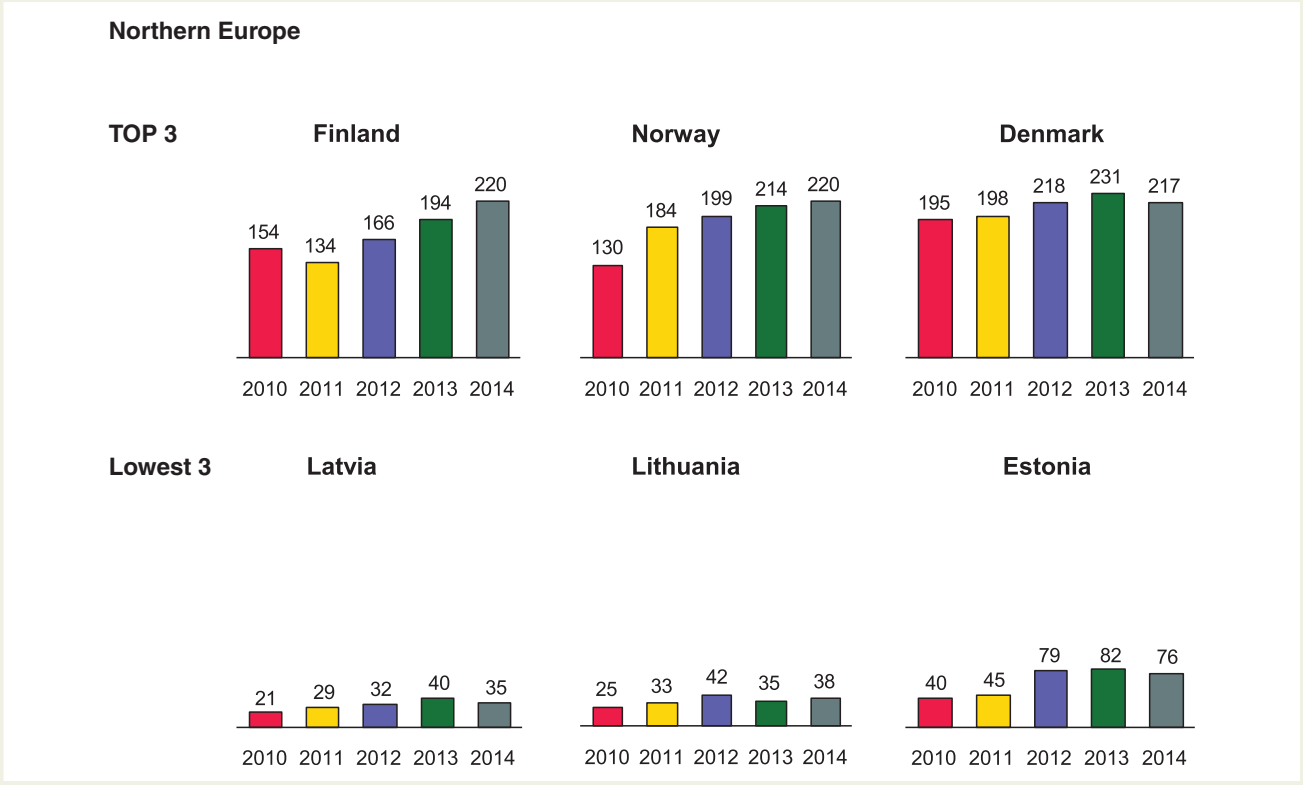

Figure 28 Implantable cardioverter-defibrillator implantations per million inhabitants 2010–14 in Northern Europe.

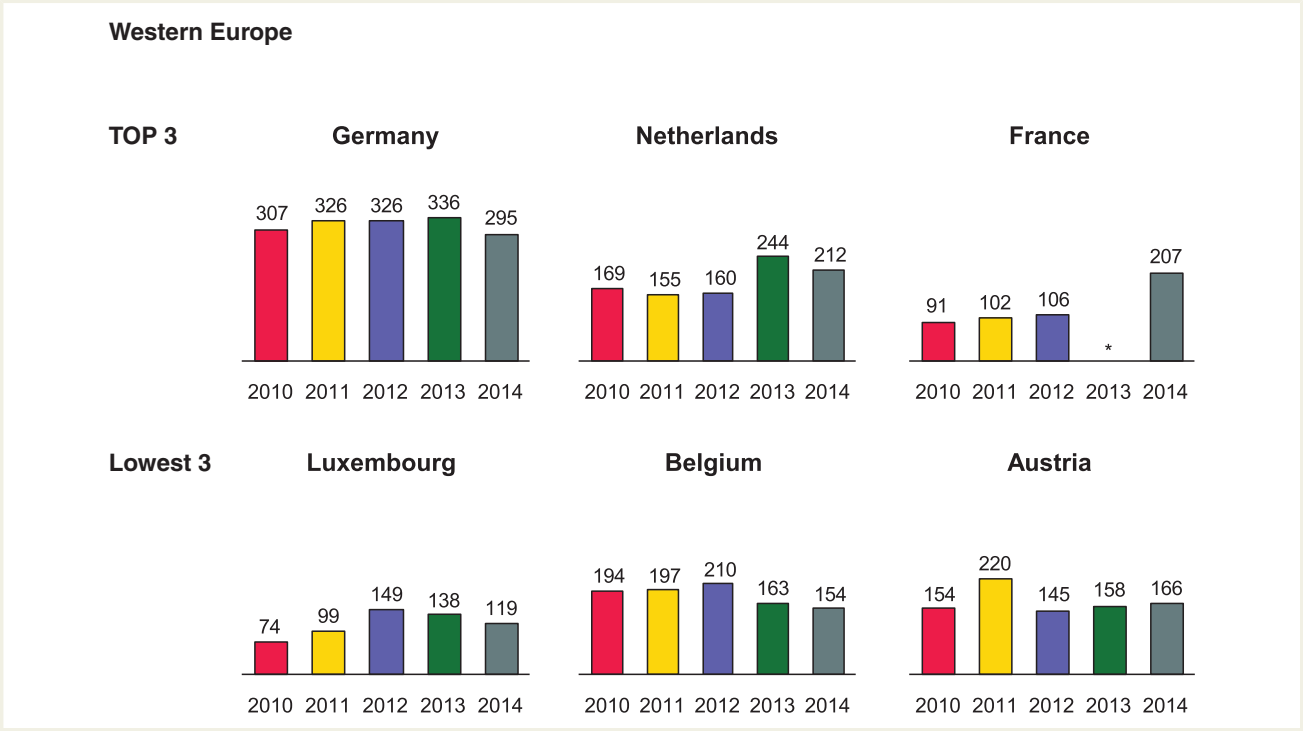

Figure 29 Implantable cardioverter-defibrillator implantations per million inhabitants 2010–14 in Western Europe. *No data available.

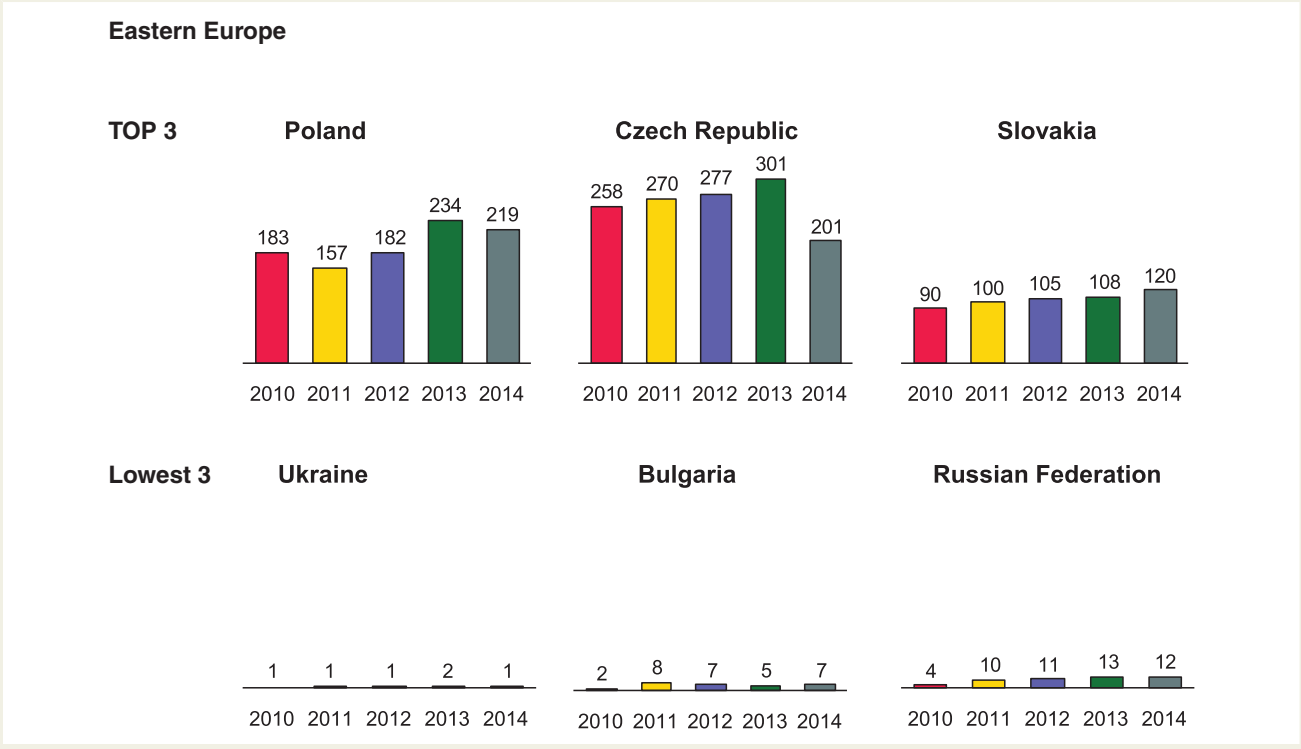

Figure 30 Implantable cardioverter-defibrillator implantations per million inhabitants 2010–14 in Eastern Europe.

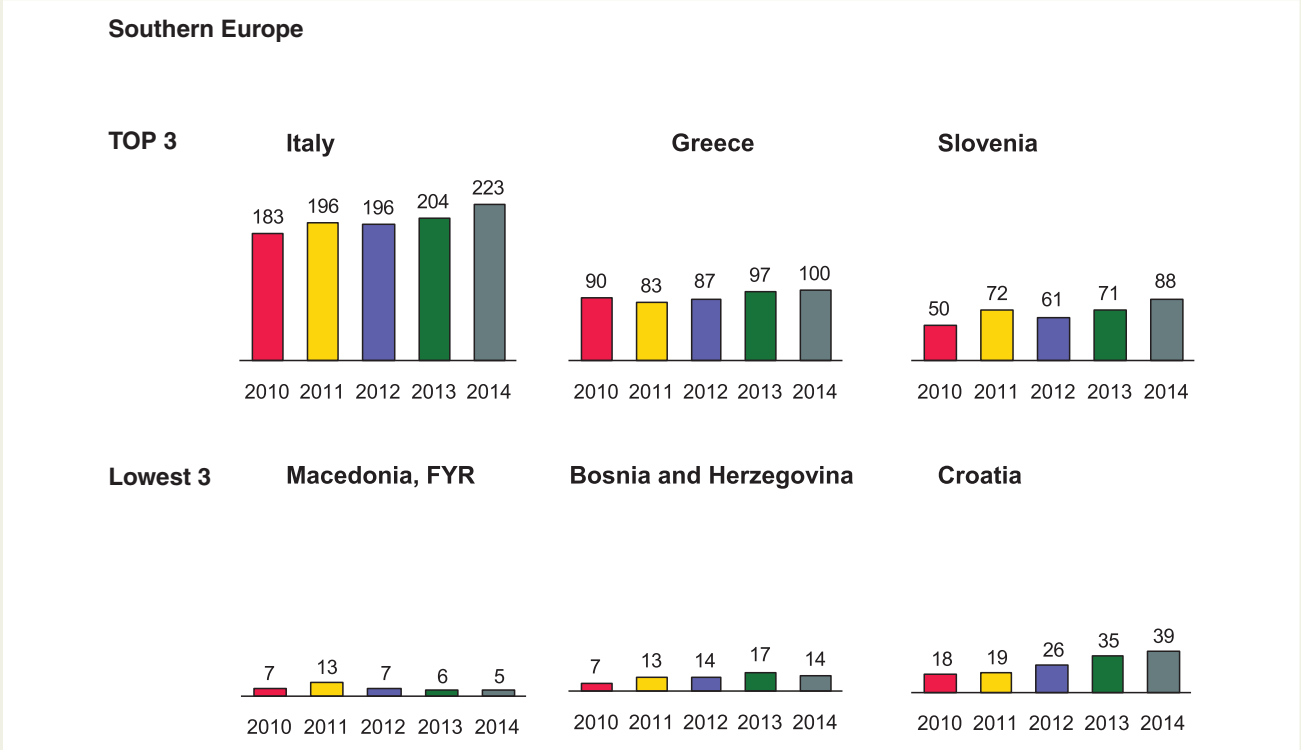

Figure 31 Implantable cardioverter-defibrillator implantations per million inhabitants 2010–14 in Southern Europe.

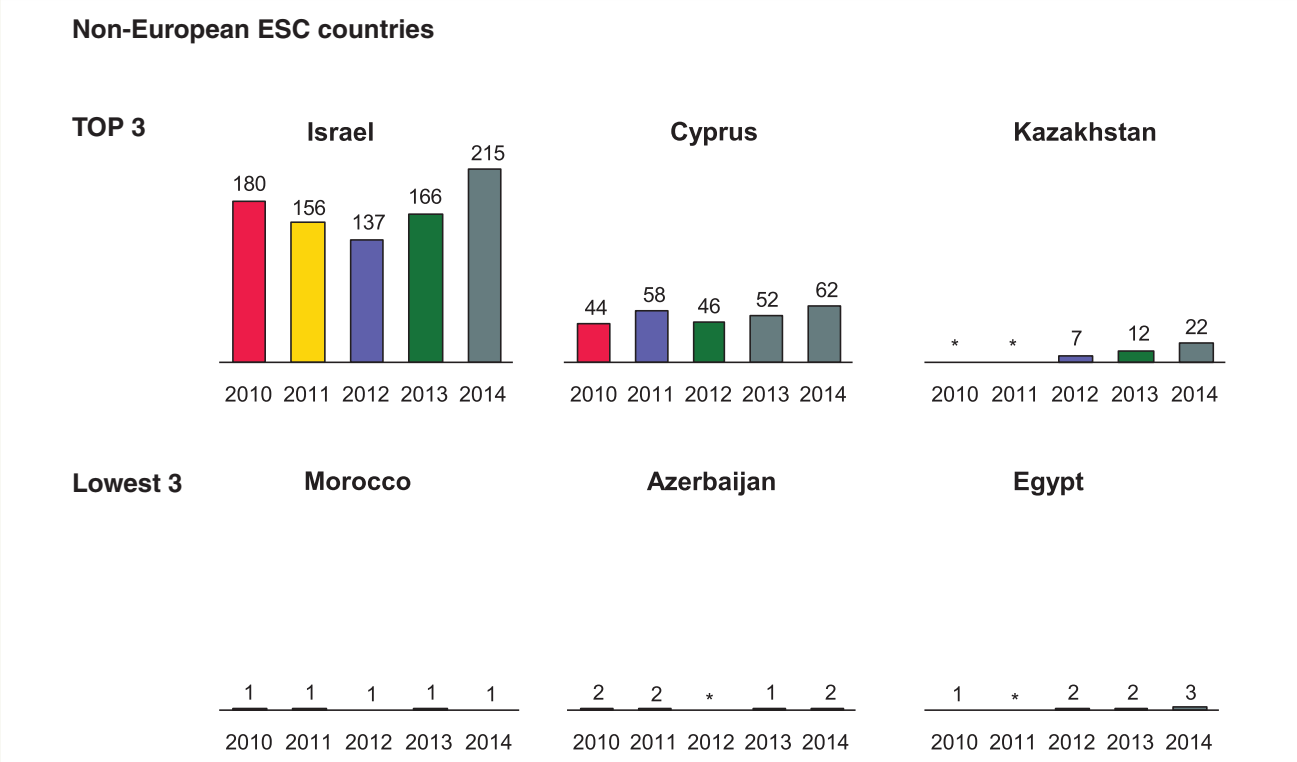

Figure 32 Implantable cardioverter-defibrillator implantations per million inhabitants 2010–14 in non-European ESC countries. *No data available.

active centre the minimum annual number of LE should be at least 15 per million inhabitants.[7–9] Assuming that each centre treated an equivalent number of patients it can be calculated that in 2014 the numbers for LE per centre were lower than recommended in most of the countries. The mean number of LE was highest in Germany (61.3 per million population) followed by Sweden (46.3) and Norway (42.5) (*Figure 55*). Owing to missing or incomplete data and a very low LE rate in some countries, interpretation of regional LE data is difficult. Therefore, we chose not to present regional data for LE.

Catheter ablation

General information

A total of 48 countries (86% of the ESC countries) submitted data on catheter ablation facilities and procedures to the EHRA White Book (*Table 15*). Twenty had a national registry on catheter ablation and in the remainder the numbers originated from a survey or an estimate by the national working groups. In 2014, a total of 1 077 479 440 people lived in the ESC countries. After excluding those countries that did not report the number of ablations or ablation centres, the population covered by the EHRA White Book for ablation procedures was 967 666 759, which is ~22% more than in the previous year. A major problem in 2014 was that no ablation data were received from Italy, which is known to have well developed catheter ablation programmes.

Catheter ablation facilities and procedure rates

In 2014, the total number of ablation centres in the countries which submitted data for the EHRA White Book was 906 (*Table 15*), and the mean number of ablation centres per million population was 1.1 (*Figure 56*). These numbers were higher than in the previous year, mainly because the French data were not available in 2013. The changes in the number or ablation centres in from 2013 to 2014 are shown in *Figure 57*.

Total number of catheter ablations in the ESC area in 2014 was 235 793 (*Table 15*), which was 63% more than that reported in 2013 (144 782). The mean number of ablations done per million population was also higher in 2014 (244) than in 2013 (184). The increase in ablation rates is mainly due to the fact that data from France were available for 2014 but not for 2013, and Germany reported a substantial increase in catheter ablations in 2014.

The number of catheter ablations per million inhabitants is shown in *Figures 58* and *59*. In these figures, the ESC countries are grouped in quartiles according to their ablation activities. As in previous years, most countries in the top quartile were from Northern and Western Europe. European Society of Cardiology countries outside Europe had low ablation activity and they are mostly found in the

Table 9 Changes in the number of ICD implantation centres in year 2013 vs. 2014

Country	ISO code	Number of ICD implanting centres 2013		Number of ICD implanting centres 2014		Change %
		Absolute number	Per mil inhabitants	Absolute number	Per mil inhabitants	
Albania	AL	N/A	N/A	2	0.66	N/A
Algeria	DZ	8	0.21	8	0.21	−1.9
Armenia	AM	2	0.65	3	0.98	50.2
Austria	AT	21	2.55	21	2.55	0.0
Azerbaijan	AZ	2	0.21	7	0.72	246.5
Belarus	BY	10	1.04	10	1.04	0.2
Belgium	BE	23	2.20	23	2.20	0.0
Bosnia & Herzegovina	BA	5	1.29	5	1.29	0.1
Bulgaria	BG	8	1.15	9	1.30	13.4
Croatia	HR	12	2.68	12	2.68	0.1
Cyprus	CY	3	2.60	4	3.41	31.4
Czech Republic	CZ	17	1.60	17	1.60	−0.2
Denmark	DK	6	1.08	6	1.08	−0.2
Egypt	EG	13	0.15	16	0.18	20.8
Estonia	EE	2	1.58	2	1.59	0.7
Finland	FI	19	3.61	19	3.61	−0.1
France	FR	148	2.24	162	2.44	9.0
Georgia	GE	7	1.42	8	1.62	14.4
Germany	DE	654	8.06	670	8.27	2.6
Greece	GR	24	2.23	24	2.23	0.0
Hungary	HU	14	1.41	13	1.31	−7.0
Iceland	IS	1	3.17	1	3.15	−0.7
Ireland	IE	17	3.56	17	3.52	−1.2
Israel	IL	20	2.60	20	2.56	−1.5
Italy	IT	365	5.94	397	6.44	8.4
Kazakhstan	KZ	12	0.68	15	0.84	23.5
Kosovo	XK	N/A	N/A	1	0.54	N/A
Kyrgyzstan	KGZ	N/A	N/A	0	0.00	N/A
Latvia	LV	2	0.92	3	1.39	50.9
Lebanon	LB	10	2.42	15	3.63	49.8
Libya[a]	LY	N/A	N/A	N/A	N/A	N/A
Lithuania	LT	3	0.85	3	0.86	0.3
Luxembourg	LU	1	1.94	1	1.92	−1.1
Macedonia, FYR	MK	2	0.96	2	0.96	−0.2
Malta	MT	1	2.43	1	2.42	−0.3
Moldova[a]	MD	0	0.00	N/A	N/A	N/A
Montenegro	ME	1	1.53	1	1.54	0.5
Morocco	MA	5	0.15	7	0.21	36.5
Netherlands	NL	31	1.84	28	1.66	−10.1
Norway	NO	11	2.16	11	2.14	−1.2
Poland	PL	118	3.07	120	3.13	1.8
Portugal	PT	27	2.50	31	2.87	14.7
Romania	RO	17	0.78	15	0.69	−11.5
Russian Federation	RU	57	0.40	55	0.39	−3.5
San Marino[a]	SM	1	30.82	N/A	N/A	N/A
Serbia	RS	8	1.10	10	1.39	25.6
Slovakia	SK	4	0.73	4	0.73	−0.1
Slovenia	SI	2	1.00	2	1.01	0.2
Spain	ES	153	3.23	112	2.35	−27.4
Sweden	SE	29	3.01	35	3.60	19.7
Switzerland	CH	46	5.75	52	6.45	12.1
Syria[a]	SY	N/A	N/A	N/A	N/A	N/A
Tunisia	TN	N/A	N/A	8	0.73	N/A
Turkey	TR	N/A	N/A	N/A	N/A	N/A
Ukraine	UA	17	0.38	8	0.18	−52.6
United Kingdom	GB	106	1.67	126	1.98	18.2

[a]These four countries did not submit data for the EHRA White Book 2015.

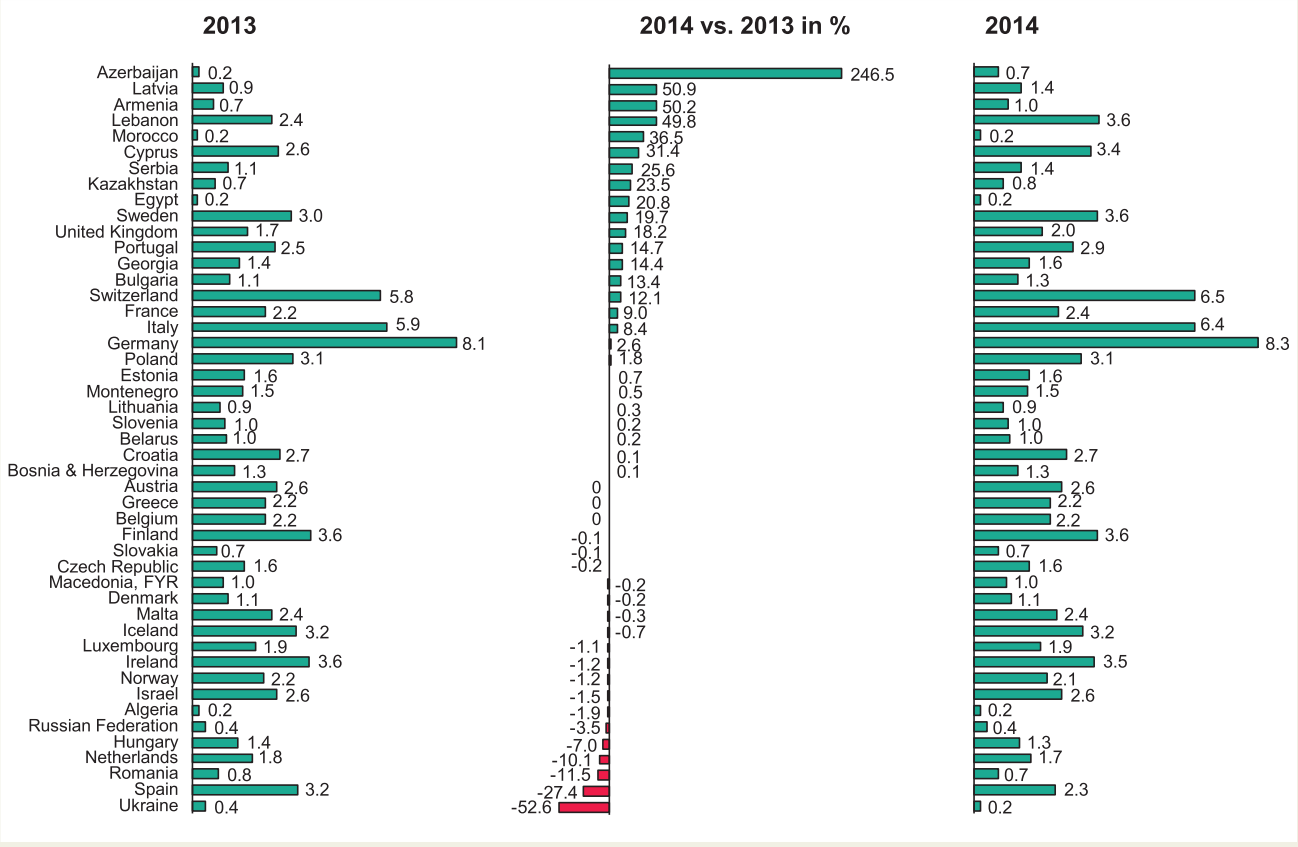

Figure 33 Change in the number of ICD implanting centres per million inhabitants from 2013 to 2014.

lowest (first) quartile. Eastern European countries had a heterogeneous distribution, which spanned over all four quartiles. Data on the number of catheter ablations during the last 5 years are shown in *Table 15*, and detailed information on the changes in the number of ablation procedures from 2013 to 2014 is presented in *Figure 60*. The mean number of ablations performed per centre increased from 193 in 2013 to 260 in 2014 indicating the centres that reported their numbers were more active than in the previous year. The relationship between the annual catheter ablation rate and the number of ablation centres per million population in the EU28 countries and the whole ESC area is shown in *Figure 61*.

More detailed data on ablation activity in the five geographical ESC regions are presented in *Figure 62*. The mean number of ablations per million inhabitants was higher in the Western and Northern Europe than in the Southern and Eastern Europe. In the non-European ESC countries, catheter ablation rate was markedly lower than in the European ESC countries (69 vs. 304 per million population). In 2014, the most active countries were Germany and Denmark with 741 and 694 ablations per million population, respectively (*Table 15* and *Figure 58*). In some of the smaller countries, no ablations were performed. Data for the last 5 years from the three most active and three least active countries in the different ESC regions are presented in *Figures 63–67*. The most active countries in the Northern, Western, Southern, and Eastern Europe were Denmark (694 ablation per million inhabitants), Germany (741), Spain (270), and the Czech Republic (551), respectively. Among the non-European ESC countries, Cyprus was the most active with 121 catheter ablations per million population. In 2014, the rate of ablations per million population increased in all other ESC countries except for Bosnia & Herzegovina, Armenia, Iceland, Ukraine, and Serbia. The growth in the mean ablation rate per million population was highest in the Eastern and Southern European region. In Cyprus, the increase in ablation rate was 211%, whereas in Serbia the ablation rate decreased by ~19% (*Figure 60*).

Atrial fibrillation ablation rates

In 2014, a total of 91 895 AF ablations were performed in the 46 ESC countries that submitted AF ablation data for the EHRA White Book (*Table 16*). In *Figures 68* and *69*, countries performing AF ablations are grouped in quartiles according to their activity. The mean number of AF ablations per million inhabitants was 93, which is ~60% more than in 2013 (58 per million). The most active countries were Germany (432 AF ablations per million population), Denmark (305), and Norway (278). Like 2013, most countries in the top quartile were from Northern and Western European region, and the countries with the lowest activity (first and second quartiles) were mainly from the Southern Europe and from the non-European ESC region. In the Eastern region, the AF ablations activity was extremely heterogeneous. The growth in AF ablation rate per million population was highest in Cyprus (771%), Germany (200%), and

Table 10 Changes in the number of ICD implantations in year 2013 vs. 2014

Country	ISO code	Number of ICD implants 2013		Number of ICD implants 2014		Change %
		Absolute number	Per mil inhabitants	Absolute number	Per mil inhabitants	
Albania	AL	N/A	N/A	4	1.32	N/A
Algeria	DZ	38	1.00	60	1.55	54.9
Armenia	AM	28	9.14	25	8.17	−10.6
Austria	AT	1296	157.63	1362	165.63	5.1
Azerbaijan	AZ	13	1.36	20	2.06	52.3
Belarus	BY	153	15.89	172	17.90	12.6
Belgium	BE	1704	163.15	1611	154.17	−5.5
Bosnia & Herzegovina	BA	65	16.77	55	14.21	−15.3
Bulgaria	BG	32	4.58	47	6.79	48.1
Croatia	HR	156	34.86	173	38.70	11.0
Cyprus	CY	60	51.93	73	62.26	19.9
Czech Republic	CZ	3196	301.23	2138	201.18	−33.2
Denmark	DK	1285	231.26	1208	216.91	−6.2
Egypt	EG	178	2.09	236	2.72	30.1
Estonia	EE	104	82.12	96	76.32	−7.1
Finland	FI	1020	193.69	1161	220.35	13.8
France	FR	N/A	N/A	13 700	206.76	N/A
Georgia	GE	59	11.94	104	21.07	76.5
Germany	DE	27 241	335.70	23 898	295.05	−12.1
Greece	GR	1050	97.47	1080	100.23	2.8
Hungary	HU	940	94.57	956	96.38	1.9
Iceland	IS	54	171.28	59	185.91	8.5
Ireland	IE	732	153.27	N/A	N/A	N/A
Israel	IL	1277	165.69	1685	215.42	30.0
Italy	IT	12 556	204.22	13 729	222.58	9.0
Kazakhstan	KZ	221	12.46	402	22.40	79.8
Kosovo	XK	N/A	N/A	3	1.61	N/A
Kyrgyzstan	KGZ	N/A	N/A	0	0.00	N/A
Latvia	LV	88	40.40	75	34.64	−14.3
Lebanon	LB	300	72.61	300	72.52	−0.1
Libya[a]	LY	N/A	N/A	N/A	N/A	N/A
Lithuania	LT	124	35.27	134	38.22	8.4
Luxembourg	LU	71	137.90	62	119.08	−13.7
Macedonia, FYR	MK	12	5.75	11	5.26	−8.5
Malta	MT	67	162.91	36	87.24	−46.4
Moldova[a]	MD	0	0.00	N/A	N/A	N/A
Montenegro	ME	38	58.15	41	63.07	8.5
Morocco	MA	34	1.04	27	0.81	−22.6
Netherlands	NL	4096	243.74	3577	211.94	−13.0
Norway	NO	1089	214.13	1134	220.29	2.9
Poland	PL	8978	233.90	8399	219.03	−6.4
Portugal	PT	N/A	N/A	N/A	N/A	N/A
Romania	RO	200	9.18	332	15.28	66.5
Russian Federation	RU	1870	13.12	1769	12.42	−5.4
San Marino[a]	SM	20	616.37	N/A	N/A	N/A
Serbia	RS	448	61.85	457	63.39	2.5
Slovakia	SK	591	107.68	658	119.80	11.2
Slovenia	SI	142	71.26	174	87.51	22.8
Spain	ES	3885	82.01	3869	81.05	−1.2
Sweden	SE	1911	198.08	2097	215.66	8.9
Switzerland	CH	1604	200.60	1341	166.35	−17.1
Syria[a]	SY	N/A	N/A	N/A	N/A	N/A
Tunisia	TN	N/A	N/A	140	12.80	N/A
Turkey	TR	N/A	N/A	6300	77.19	N/A
Ukraine	UA	85	1.91	57	1.29	−32.5
United Kingdom	GB	5809	91.63	6474	101.56	10.8
Total ESC countries	56					

[a]These four countries did not submit data for the EHRA White Book 2015.

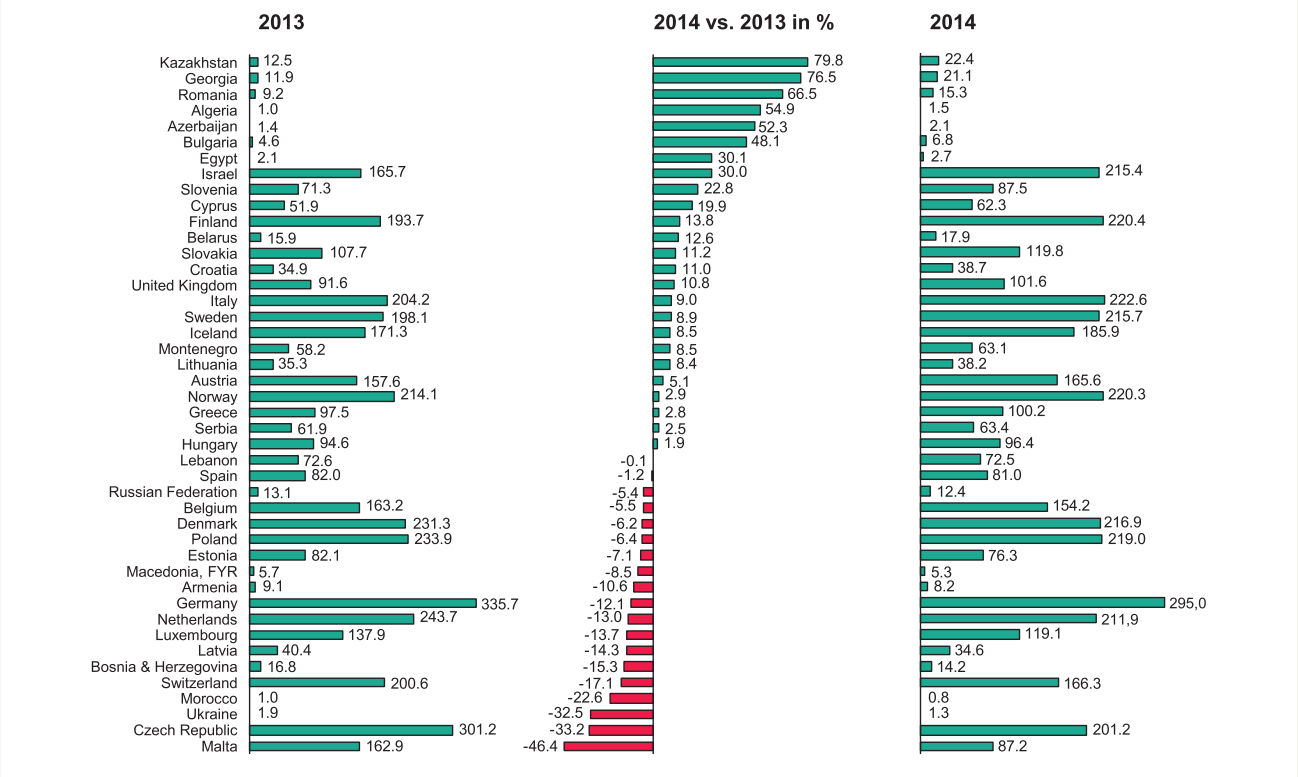

Figure 34 Change in the number of ICD implantations per million inhabitants from 2013 to 2014.

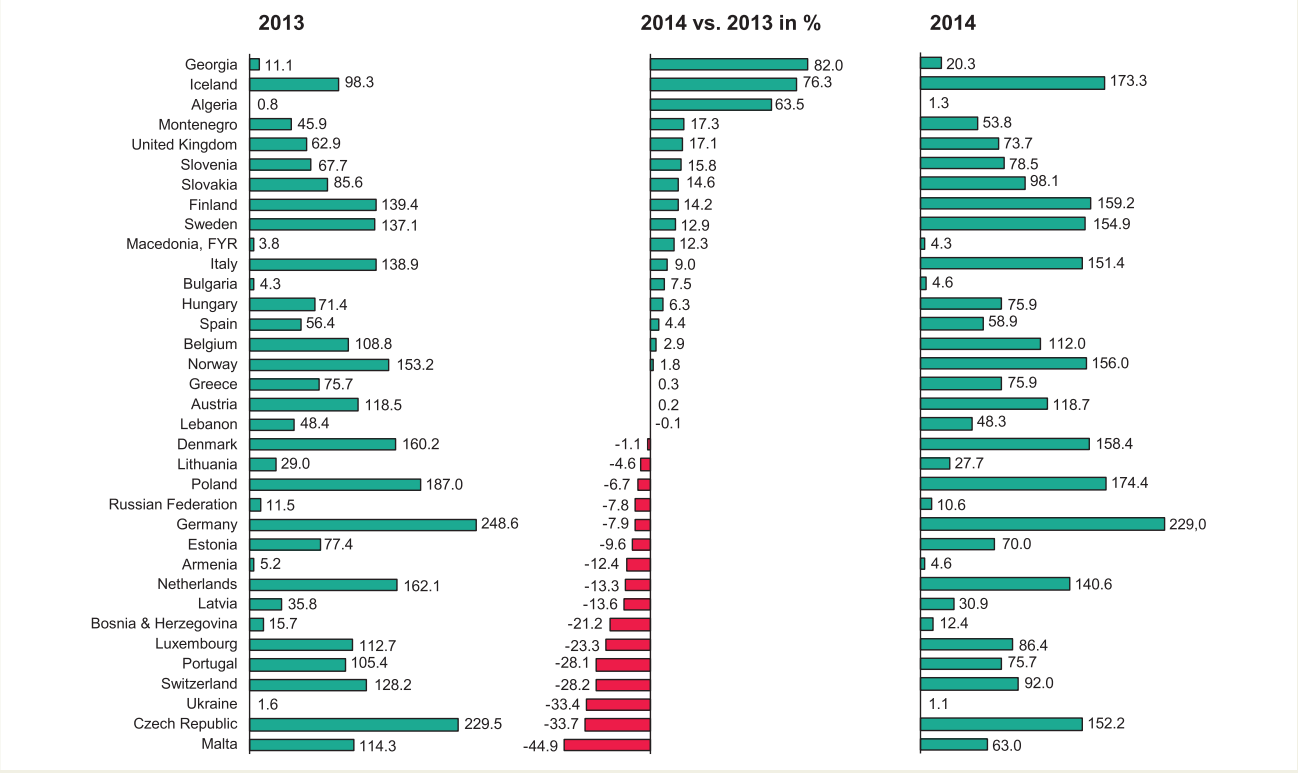

Figure 35 Change in the number of new ICD implantations per million inhabitants from 2013 to 2014.

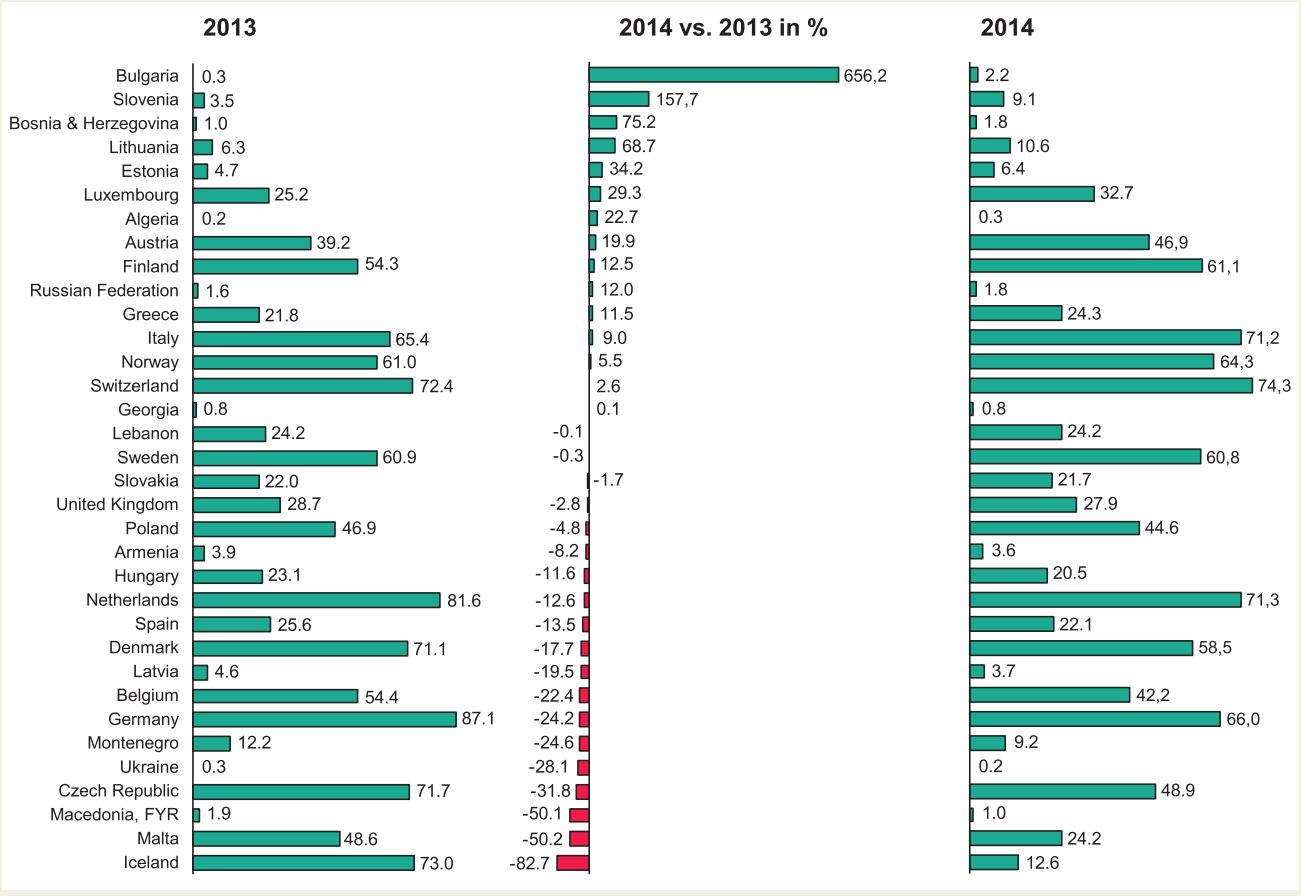

Figure 36 Change in the number of ICD replacements per million inhabitants from 2013 to 2014.

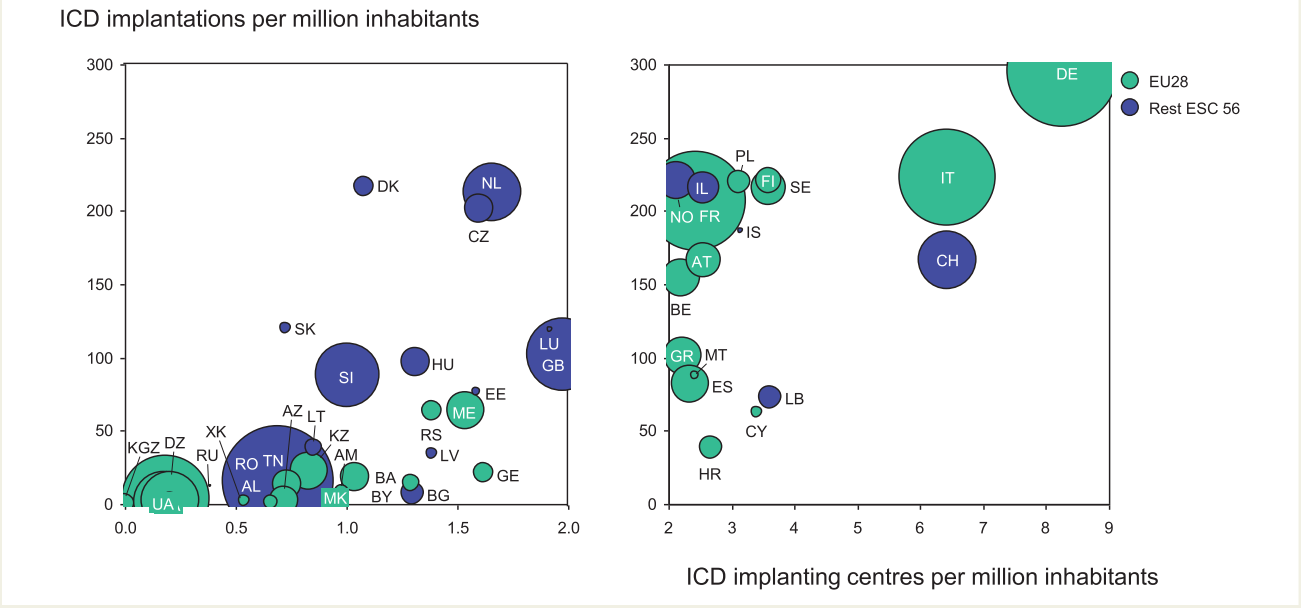

Figure 37 Implantable cardioverter-defibrillator implantation centres and rates in the ESC and European Union (EU28) member countries in 2014. Bubble size is related to population in the country. The ISO codes of the countries are explained in *Table 1*.

Table 11 Cardiac resynchronization therapy device (CRT-P and CRT-D) implantation facilities and rates in the ESC countries in 2014 and comparison to four previous years

Country	ISO code	Number of CRT implanting centres 2014		CRT implantations 2014		Total CRT implantations 2014		Development potential—target number of CRT implantations		CRT implantations per mil inhabitants				
		Absolute number	Per mil inhabitants	CRT-P implantations Absolute number	CRT-D implantations Absolute number	Absolute number	Per mil inhabitants	To attain mean ESC area level	To attain mean EU28 level	2010	2011	2012	2013	2014
Albania	AL	1	0.33	2	0	2	1	200	365	N/A	N/A	N/A	N/A	1
Algeria	DZ	8	0.21	20	36	56	1	2571	4694	N/A	N/A	N/A	2	1
Armenia	AM	3	0.98	0	4	4	1	203	370	2	3	6	3	1
Austria	AT	18	2.19	420	816	1236	150	–	–	122	117	107	143	150
Azerbaijan	AZ	3	0.31	0	18	18	2	642	1172	2	2	N/A	2	2
Belarus	BY	6	0.62	N/A	N/A	49	5	637	1162	4	5	4	6	5
Belgium	BE	40	3.83	458	874	1332	127	–	–	51	58	82	117	127
Bosnia & Herzegovina	BA	2	0.52	13	10	23	6	256	468	2	6	5	6	6
Bulgaria	BG	7	1.01	268	35	303	44	459	838	11	12	28	37	44
Croatia	HR	11	2.46	85	39	124	28	296	541	10	12	13	18	28
Cyprus	CY	4	3.41	N/A	N/A	29	25	78	142	29	21	25	22	25
Czech Republic	CZ	17	1.60	416	1456	1872	176	–	–	122	143	127	162	176
Denmark	DK	5	0.90	415	550	965	173	–	–	102	158	170	180	173
Egypt	EG	16	0.18	420	110	530	6	5757	10 510	3	N/A	4	5	6
Estonia	EE	2	1.59	27	24	51	41	83	152	40	58	53	55	41
Finland	FI	15	2.85	181	345	526	100	–	637	51	62	72	83	100
France	FR	146	2.20	3500	6070	9570	144	–	–	114	123	131	N/A	144
Georgia	GE	7	1.42	11	44	55	11	327	597	3	3	7	8	11
Germany	DE	670	8.27	3289	16 300	19 589	242	–	–	178	202	221	109	242
Greece	GR	16	1.48	80	500	580	54	714	1303	35	37	45	46	54
Hungary	HU	13	1.31	471	470	941	95	–	1200	83	81	89	99	95
Iceland	IS	1	3.15	16	10	26	82	–	38	36	48	32	44	82
Ireland	IE	17	3.52	N/A	N/A	N/A	N/A	N/A	N/A	48	57	61	79	N/A
Israel	IL	20	2.56	80	1250	1330	170	–	–	112	97	118	158	170
Italy	IT	378	6.13	2112	10 224	12 336	200	–	–	194	203	194	198	200
Kazakhstan	KZ	13	0.72	N/A	N/A	262	15	1189	2171	N/A	N/A	9	12	15

Kosovo	XK	0	0.00	0	0	0	0	123	225	N/A	N/A	N/A	N/A	0
Kyrgyzstan	KGZ	0	0.00	0	0	0	0	371	678	N/A	N/A	N/A	N/A	0
Latvia	LV	2	0.92	28	77	105	48	143	262	31	24	35	29	48
Lebanon	LB	15	3.63	10	150	160	39	274	500	N/A	N/A	N/A	24	39
Libya[a]	LY	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Lithuania	LT	3	0.86	160	32	192	55	232	424	20	31	39	47	55
Luxembourg	LU	1	1.92	10	24	34	65	34	63	40	40	59	43	65
Macedonia, FYR	MK	2	0.96	25	3	28	13	139	253	4	13	5	8	13
Malta	MT	1	2.42	5	43	48	116	–	50	61	56	83	39	116
Moldova[a]	MD	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	N/A
Montenegro	ME	1	1.54	12	10	22	34	43	79	25	21	29	15	34
Morocco	MA	7	0.21	45	17	62	2	2218	4049	N/A	N/A	2	2	2
Netherlands	NL	31	1.84	514	1417	1931	114	–	2041	127	130	124	123	114
Norway	NO	10	1.94	197	317	514	100	–	623	72	88	77	84	100
Poland	PL	35	0.91	717	3001	3718	97	–	4638	61	66	73	78	97
Portugal	PT	24	2.22	178	518	696	64	716	1308	42	41	52	N/A	64
Romania	RO	12	0.55	166	123	289	13	1440	2628	10	10	7	9	13
Russian Federation	RU	42	0.29	45	818	863	6	9439	17 232	3	6	6	7	6
San Marino[a]	SM	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	127	94	62	0	N/A
Serbia	RS	6	0.83	243	78	321	45	478	872	19	40	42	45	45
Slovakia	SK	6	1.09	136	393	529	96	–	664	74	60	61	82	96
Slovenia	SI	2	1.01	57	93	150	75	–	240	46	45	70	66	75
Spain	ES	130	2.72	949	2025	2974	62	3163	5774	41	56	53	54	62
Sweden	SE	15	1.54	308	546	854	88	–	1176	84	N/A	49	100	88
Switzerland	CH	48	5.95	208	375	583	72	–	975	74	74	66	60	72
Syria[a]	SY	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tunisia	TN	8	0.73	120	60	180	16	725	1323	8	8	23	N/A	16
Turkey	TR	N/A	N/A	310	2150	2460	30	5407	9872	N/A	N/A	N/A	N/A	30
Ukraine	UA	9	0.20	72	13	85	2	2934	5357	1	1	1	2	2
United Kingdom	GB	129	2.02	4144	5372	9516	149	–	–	105	105	110	122	149
TOTAL	56	1978		20 943	56 840	78 123								

[a]These four countries did not submit data for the EHRA White Book 2015.

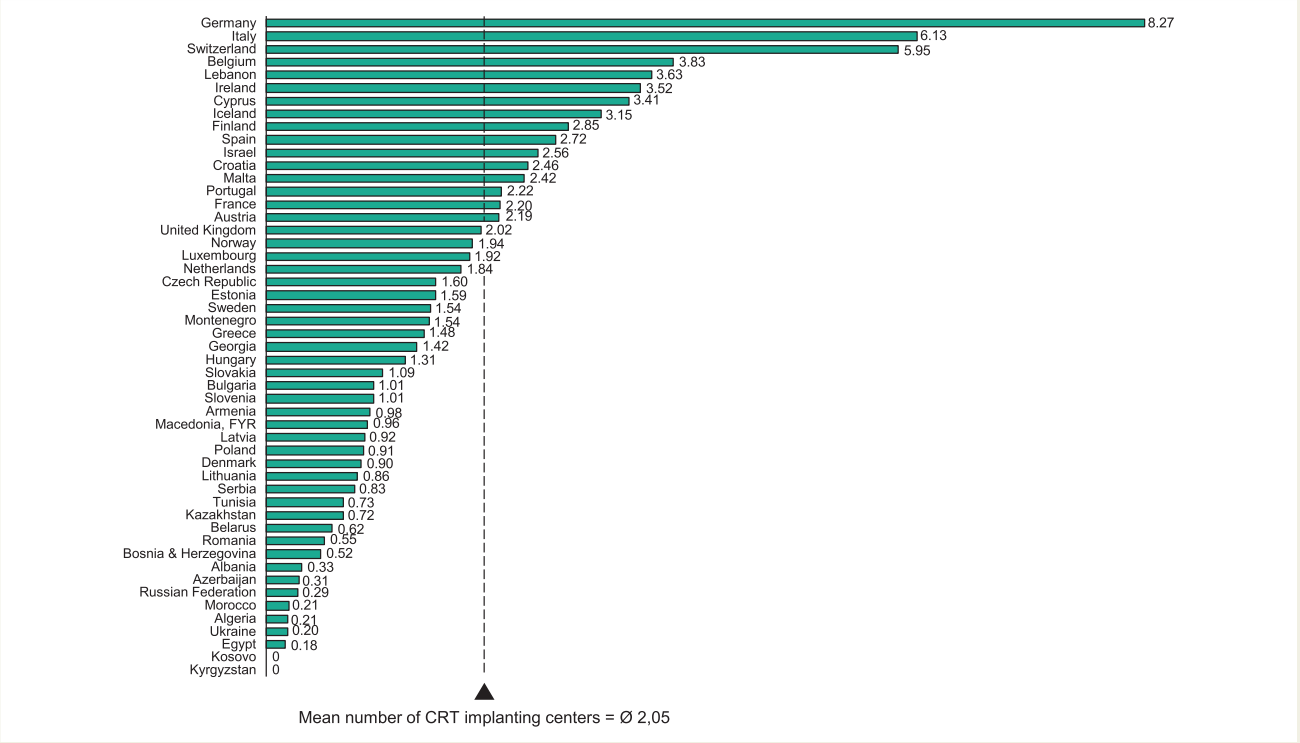

Figure 38 Cardiac resynchronization therapy device implanting centres per million inhabitants in 2014. The mean number of CRT implantation centres is weighted by population.

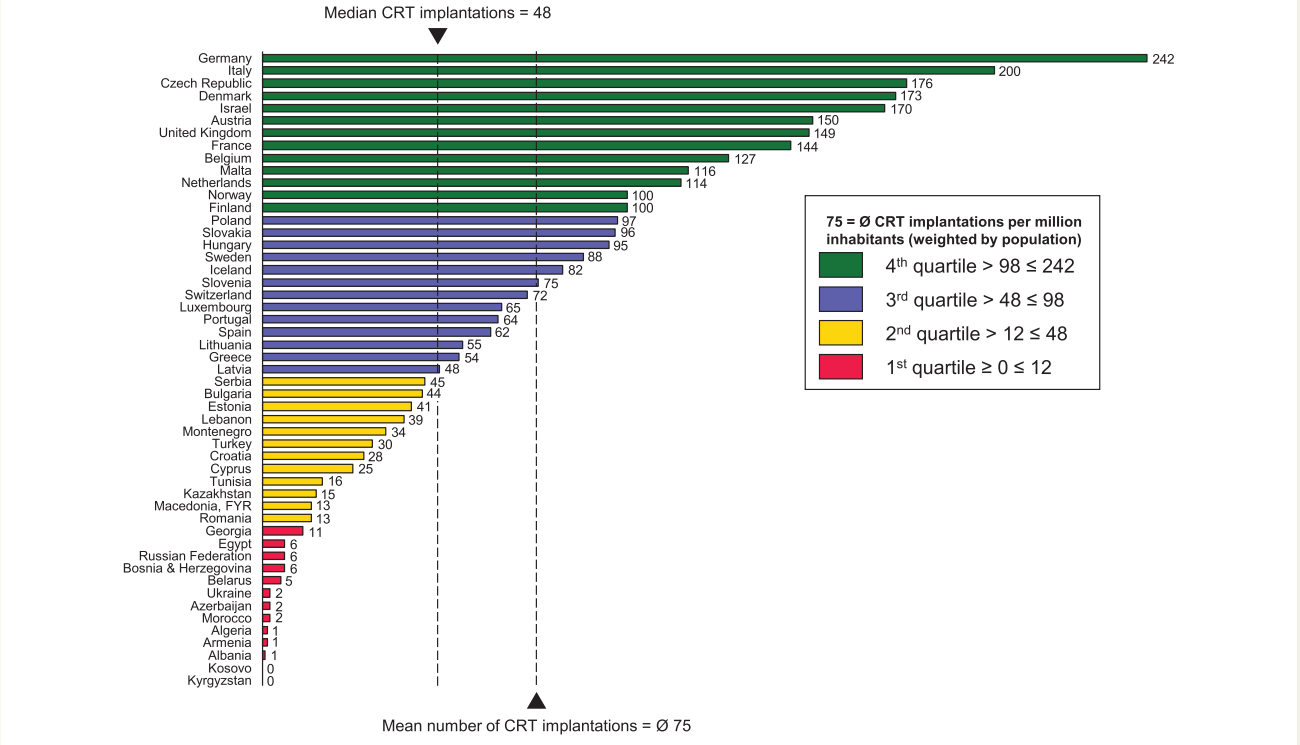

Figure 39 Cardiac resynchronization therapy device implantations per million inhabitants 2014. The mean number of CRT implantations is weighted by population.

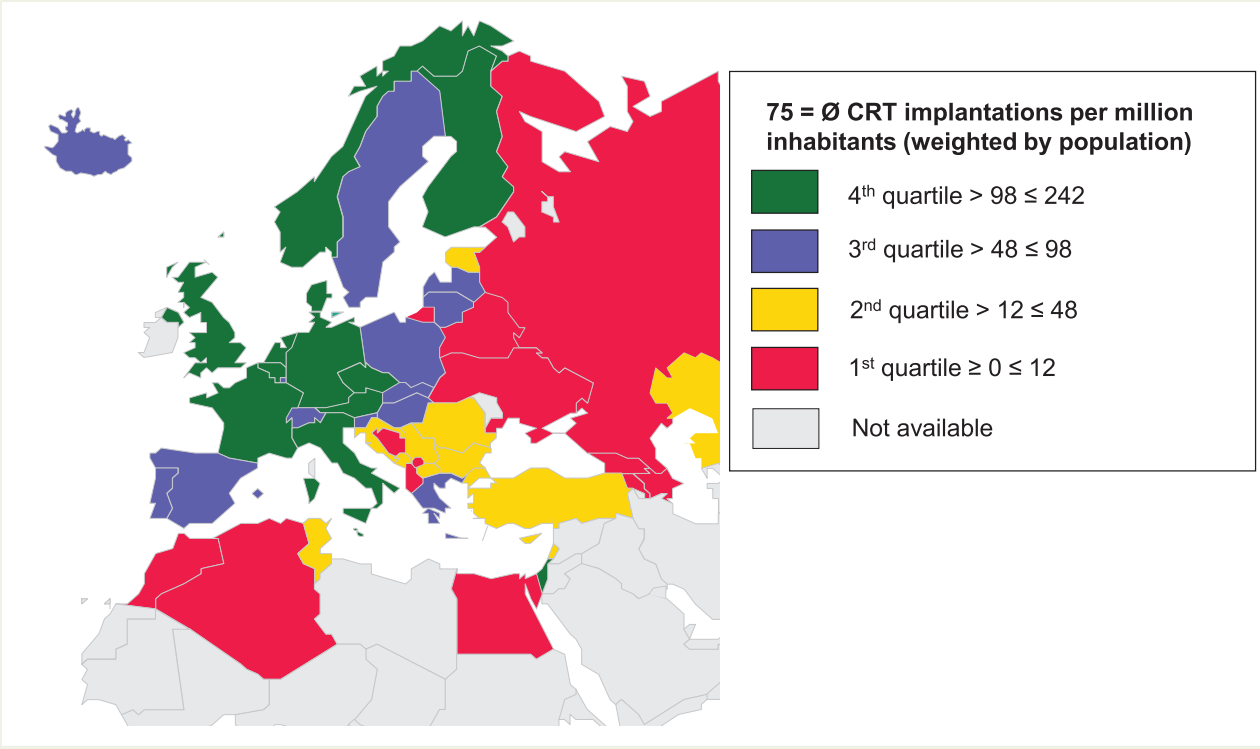

Figure 40 Cardiac resynchronization therapy device implantations per million inhabitants in the ESC countries in 2014.

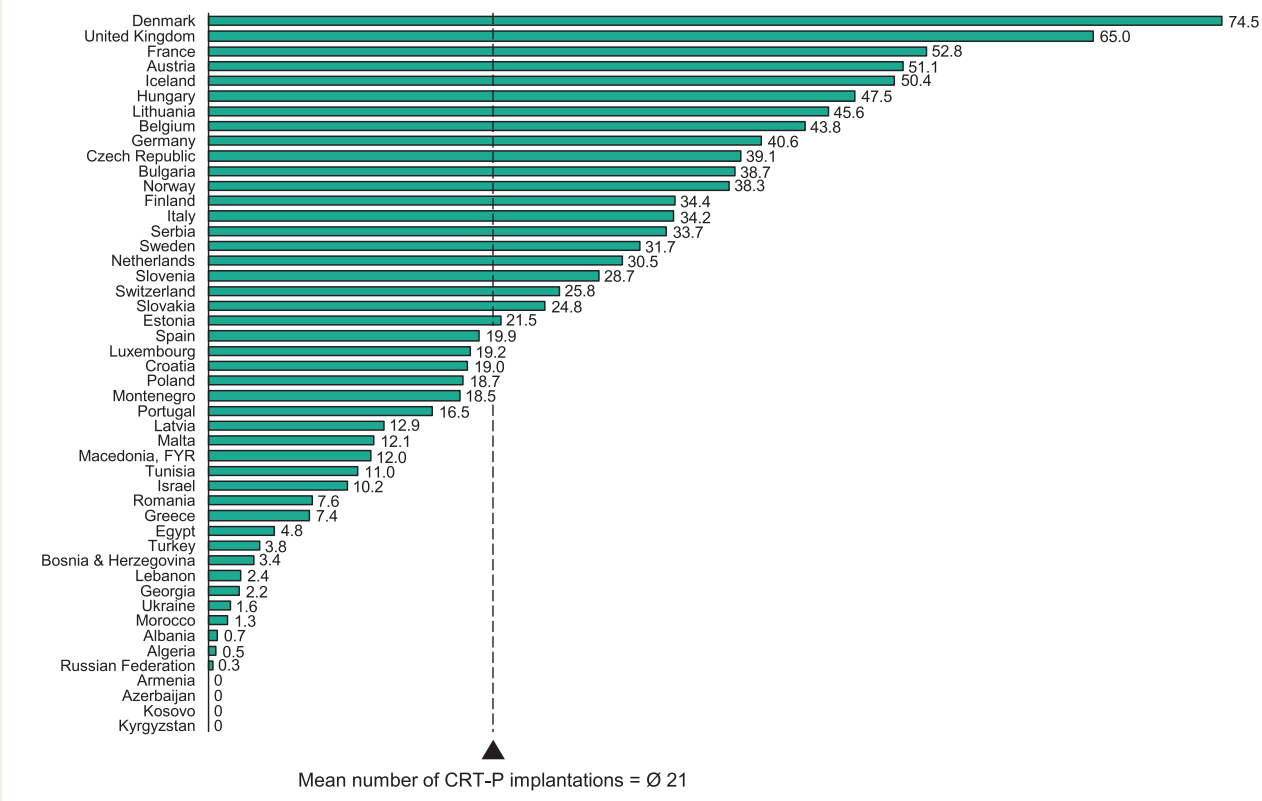

Figure 41 Cardiac resynchronization therapy pacemaker implantations per million inhabitants in 2014. The mean number of implantations is weighted by population.

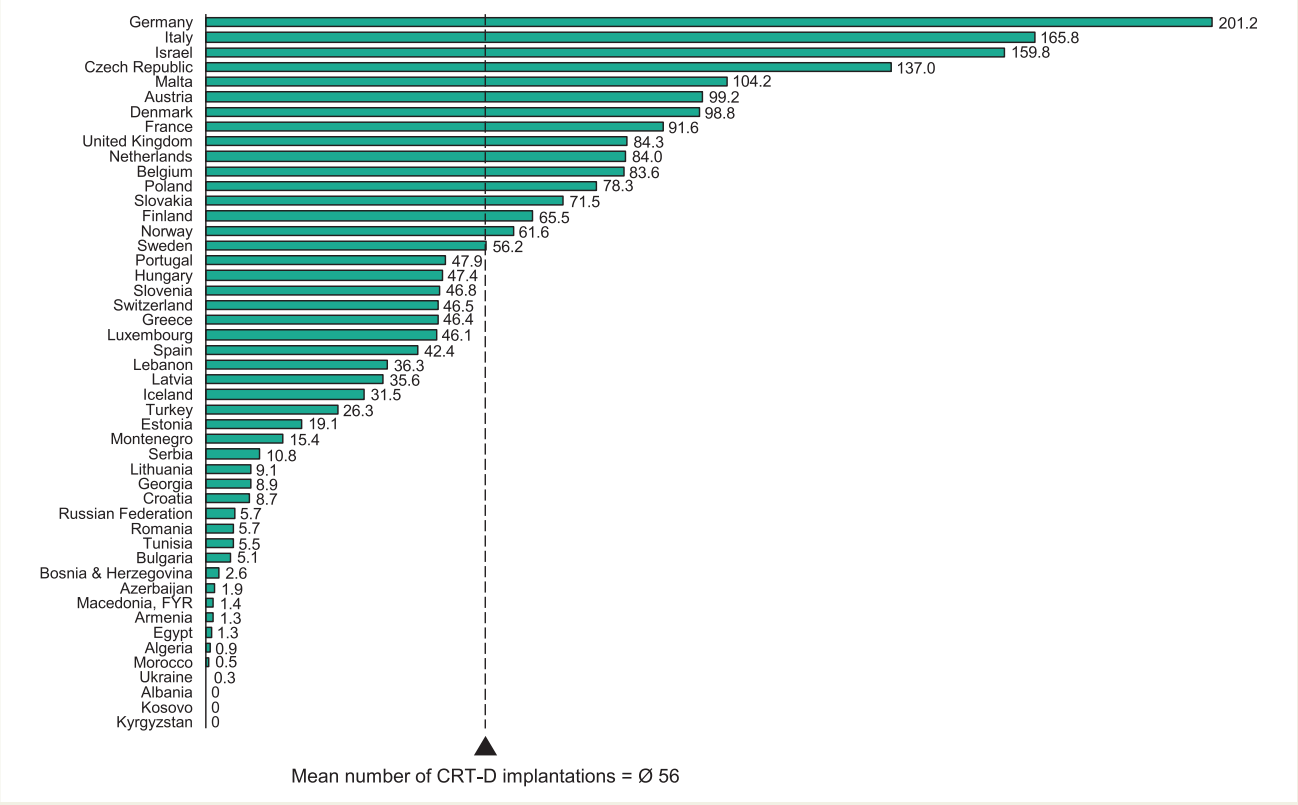

Figure 42 Cardiac resynchronization therapy defibrillator implantations per million inhabitants in 2014. The mean number of implantations is weighted by population.

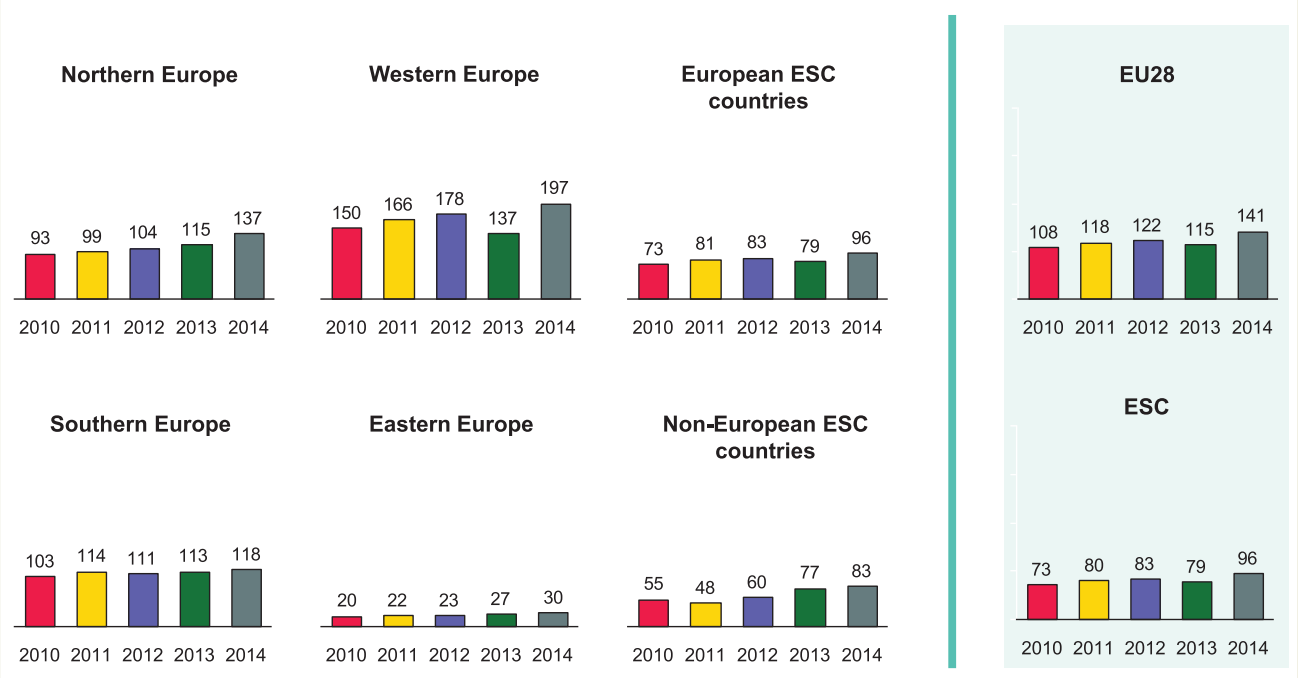

Figure 43 Cardiac resynchronization therapy device implantations per million inhabitants 2010–14 in the five geographical regions of the ESC and comparison to the total ESC area and the 28 member countries of the European Union (EU28).

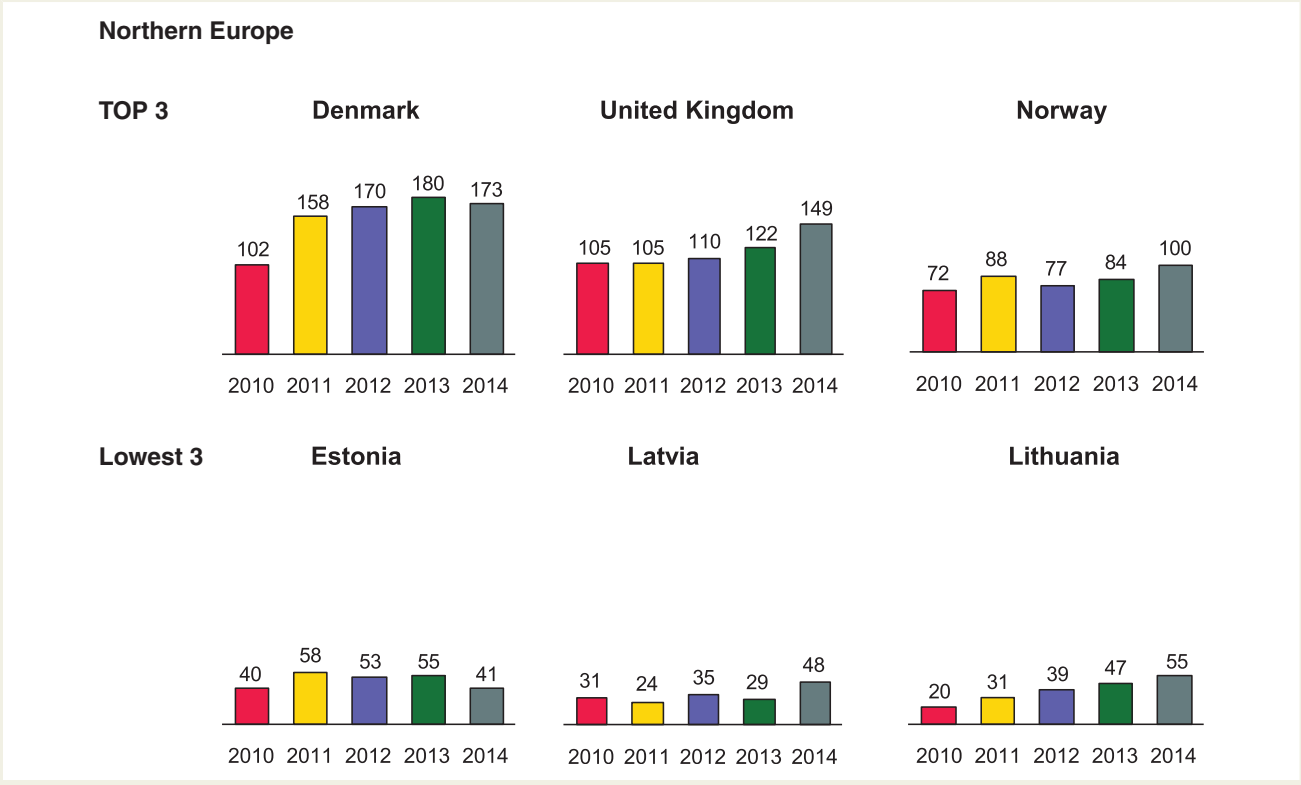

Figure 44 Cardiac resynchronization therapy implantations per million inhabitants 2010–14 in Northern Europe.

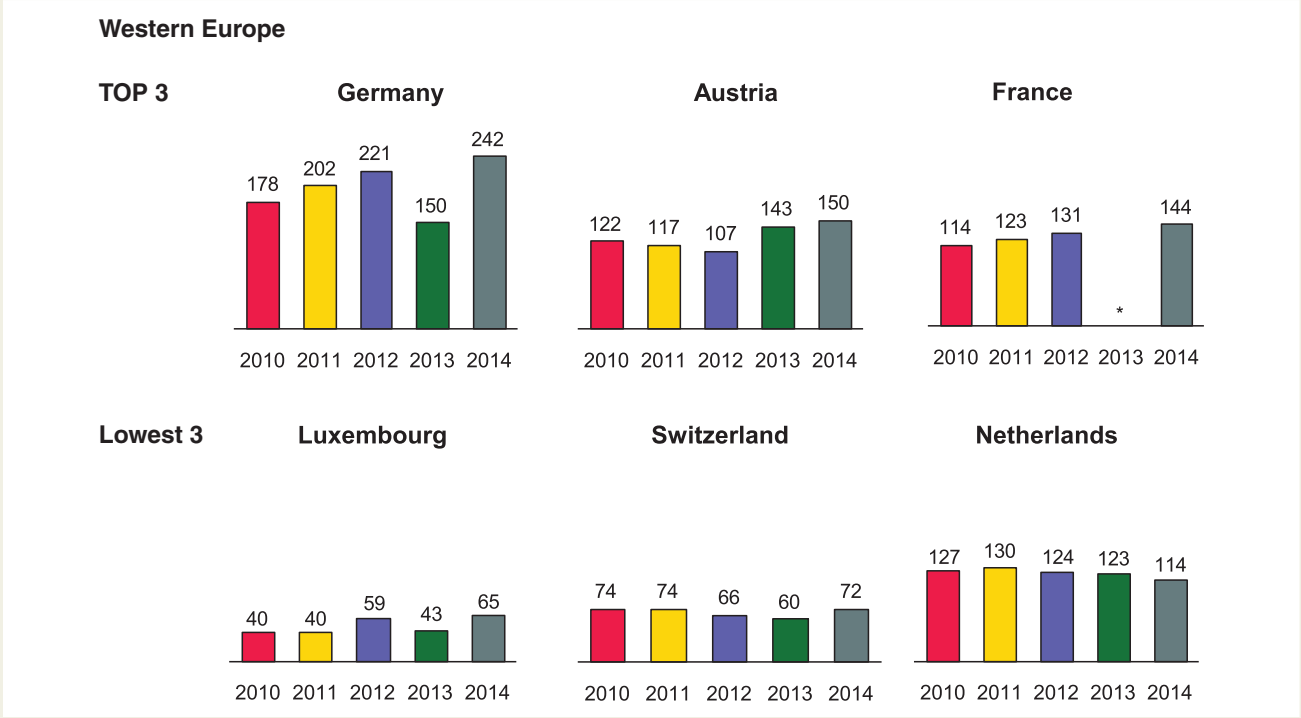

Figure 45 Cardiac resynchronization therapy implantations per million inhabitants 2010–14 in Western Europe. *No data available.

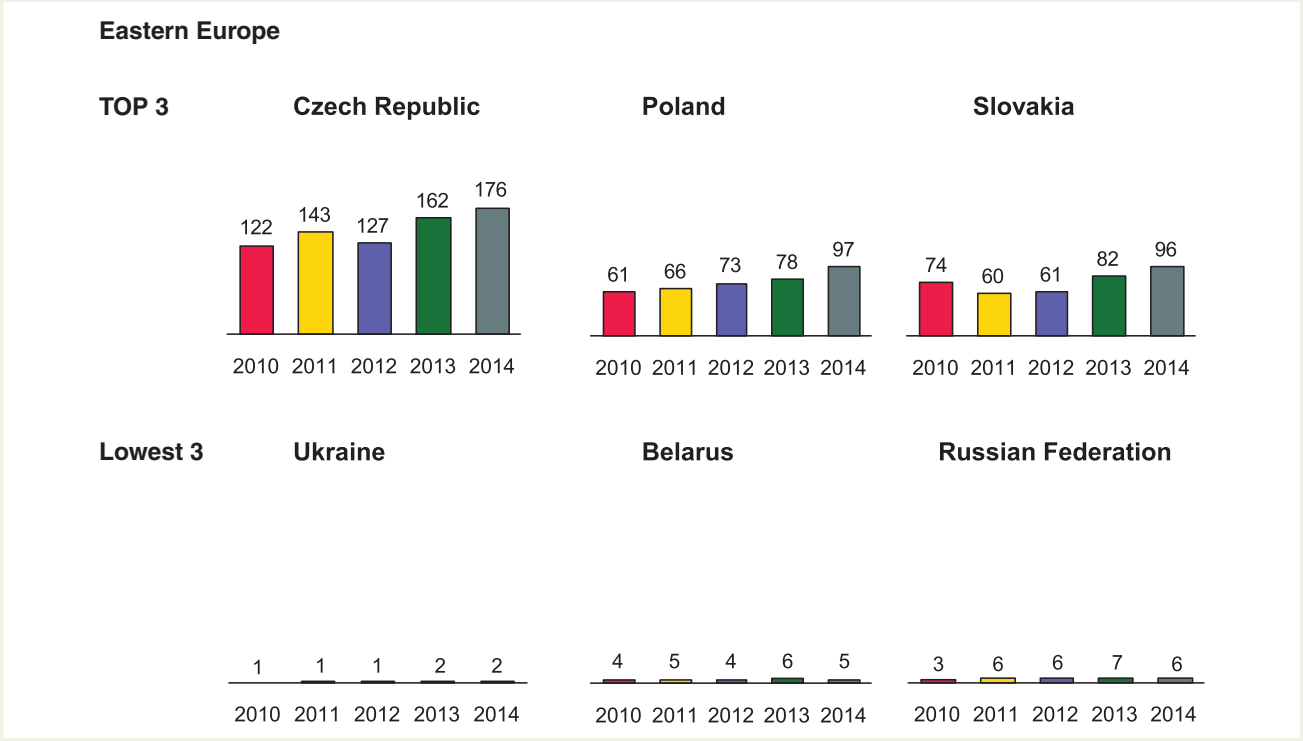

Figure 46 Cardiac resynchronization therapy implantations per million inhabitants 2010–14 in Eastern Europe.

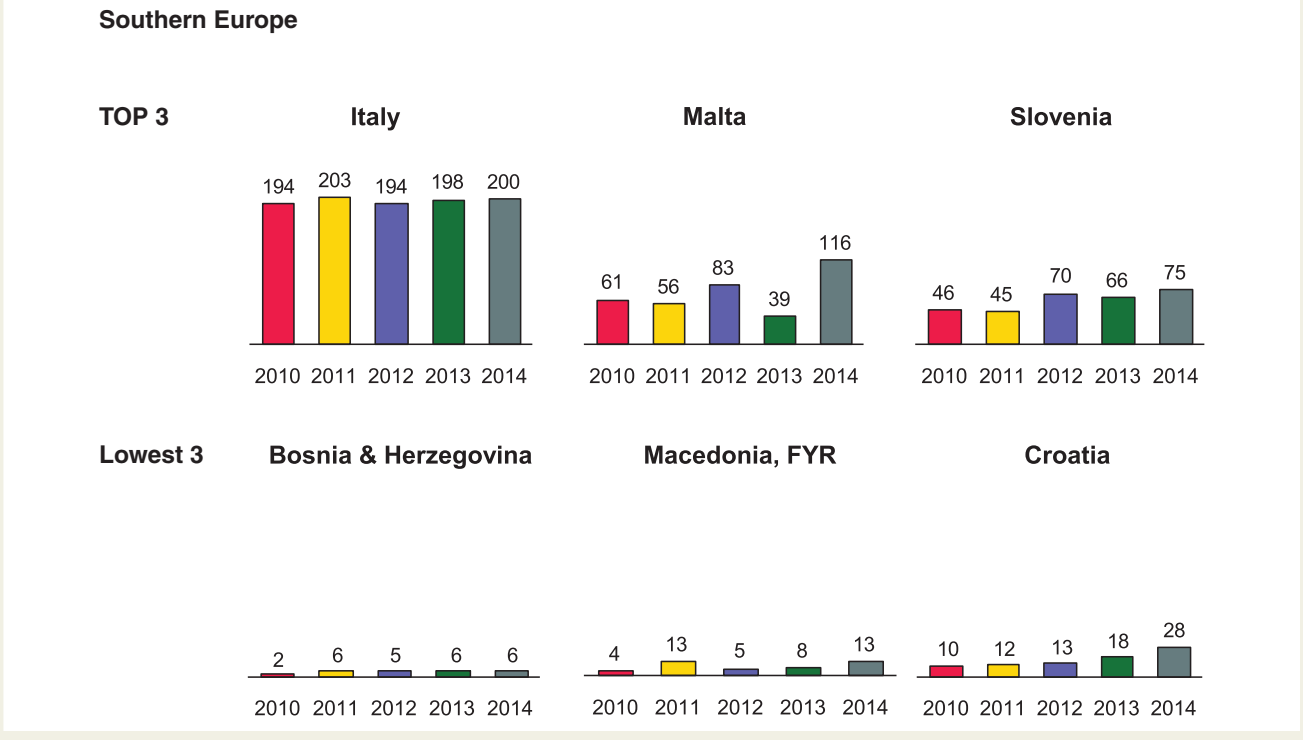

Figure 47 Cardiac resynchronization therapy implantations per million inhabitants 2010–14 in Southern Europe.

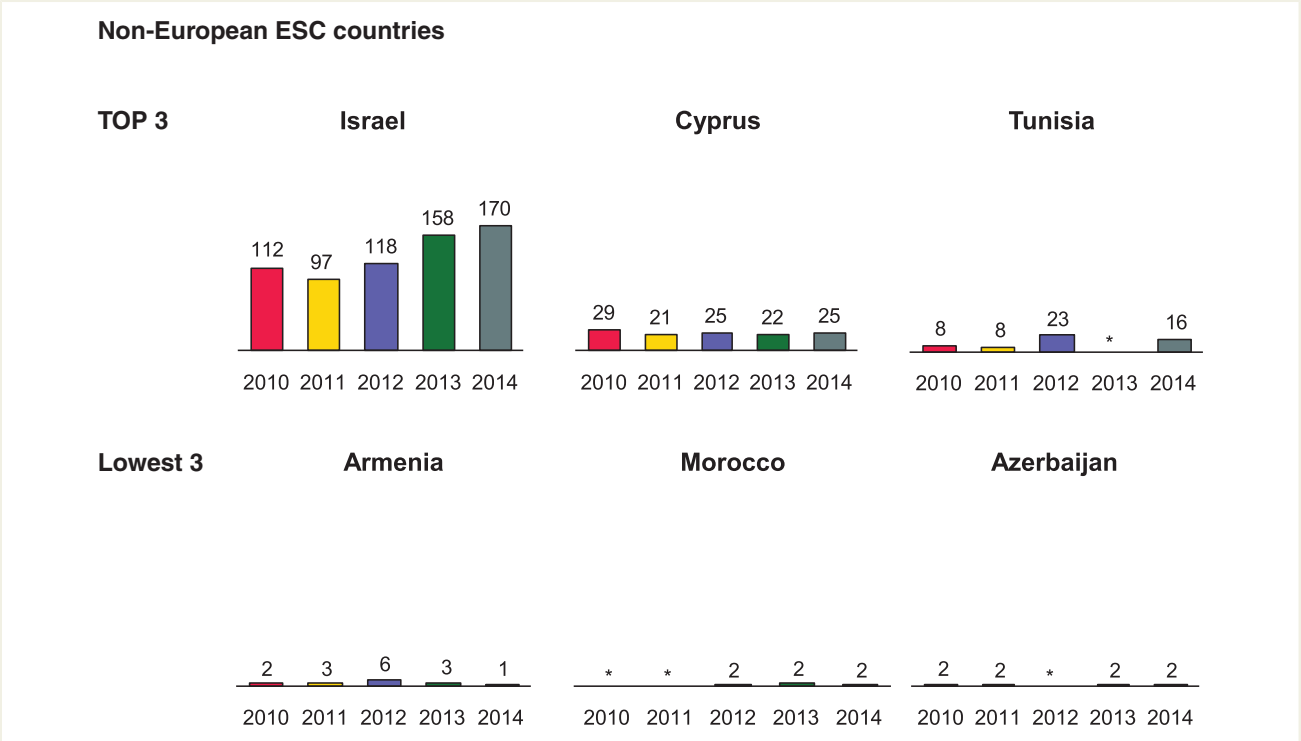

Figure 48 Cardiac resynchronization therapy implantations per million inhabitants 2010–14 in non-European ESC countries. *No data available.

Lithuania (147%), whereas in Romania, Slovakia, and Slovenia the AF ablation rate decreased by 27, 14, and 10%, respectively (*Figure 70*). In Algeria, Bosnia & Herzegovina, Kosovo, Malta, and FYR Macedonia, no AF ablations were performed in 2014.

Detailed data on AF ablation activities in the five ESC regions and a comparison to the corresponding numbers in the ESC and EU28 countries are presented in *Figure 71*. The rate of AF ablations was markedly lower in the non-European than in the European ESC countries (12 vs. 124 per million population). The most active countries in the Northern, Western, Southern, and Eastern European region, and among the non-European ESC countries were Denmark (305 AF ablation per million population), Germany (432), Slovenia (75), the Czech Republic (216) and Cyprus (45) (*Figures 72–76*). The proportion of AF ablation to the total number of ablation varied between 0.5% in Azerbaijan and 58.3% in Germany. The proportion of AF ablations compared with all ablations was more than 40% in six countries (*Figure 77*).

Ventricular tachyarrhythmia ablation rates

Data on ventricular tachyarrhythmia ablations in patients with structural heart disease were collected for the first time in 2014. A total of 37 (66%) countries reported data on ventricular tachycardia (VT) or ventricular fibrillation (VF) ablations. In 2014, the number of centres performing more than 10 ventricular tachyarrhythmia ablations for patients with structural heart disease per million population was highest in Slovakia (1.01) and lowest in Ukraine (0.05) (*Figure 78*). The mean number of VT/VF ablations per million population in the ESC countries was 9.2. It was highest in the Netherlands (50 per million population), Czech Republic (27), and Denmark (26) (*Figures 79* and *80*). Many countries did not report any data on VT/VF ablation ($n = 19$) or did not perform any VT/VF ablations in 2014 ($n = 8$).

Percutaneous left atrial appendage closures

During recent years, percutaneous left atrial appendage (LAA) closure has become a viable option to prevention AF-related thromboembolic complications among patients with high risk of bleeding and relative or absolute contraindication to oral anticoagulation therapy.[10,11] In 2014, only 32 of the 56 ESC member countries (57%) submitted the requested data on LAA closures for the EHRA White Book. The mean number of centres performing LAA closures was 0.4 per million population. There were no centres performing LAA closure centres in 14 countries (*Figure 81*). The mean number of procedures in the ESC countries performing LAA closures was 8.9 per million inhabitants. Germany was by far the most active country (43 LAA closure per million inhabitant) followed by Finland (12.0) and Latvia (8.3) (*Figure 82*).

Table 12 Changes in the number of CRT device implanting centres in year 2013 vs. 2014

Country	ISO code	Number of CRT implanting centres 2013		Number of CRT implanting centres 2014		Change %
		Absolute number	Per mil inhabitants	Absolute number	Per mil inhabitants	
Albania	AL	N/A	N/A	1	0.33	N/A
Algeria	DZ	8	0.21	8	0.21	−1.9
Armenia	AM	2	0.65	3	0.98	50.2
Austria	AT	18	2.19	18	2.19	0.0
Azerbaijan	AZ	2	0.21	3	0.31	48.5
Belarus	BY	5	0.52	6	0.62	20.2
Belgium	BE	35	3.35	40	3.83	14.2
Bosnia & Herzegovina	BA	2	0.52	2	0.52	0.1
Bulgaria	BG	8	1.15	7	1.01	−11.8
Croatia	HR	7	1.56	11	2.46	57.3
Cyprus	CY	3	2.60	4	3.41	31.4
Czech Republic	CZ	17	1.60	17	1.60	−0.2
Denmark	DK	5	0.90	5	0.90	−0.2
Egypt	EG	13	0.15	16	0.18	20.8
Estonia	EE	2	1.58	2	1.59	0.7
Finland	FI	14	2.66	15	2.85	7.1
France	FR	159	2.41	146	2.20	−8.6
Georgia	GE	6	1.21	7	1.42	16.8
Germany	DE	465	5.73	670	8.27	44.4
Greece	GR	16	1.49	16	1.48	0.0
Hungary	HU	13	1.31	13	1.31	0.2
Iceland	IS	1	3.17	1	3.15	−0.7
Ireland	IE	17	3.56	17	3.52	−1.2
Israel	IL	20	2.60	20	2.56	−1.5
Italy	IT	361	5.87	378	6.13	4.4
Kazakhstan	KZ	9	0.51	13	0.72	42.7
Kosovo	XK	N/A	N/A	0	0.00	N/A
Kyrgyzstan	KGZ	N/A	N/A	0	0.00	N/A
Latvia	LV	2	0.92	2	0.92	0.6
Lebanon	LB	5	1.21	15	3.63	199.6
Libya[a]	LY	N/A	N/A	N/A	N/A	N/A
Lithuania	LT	3	0.85	3	0.86	0.3
Luxembourg	LU	1	1.94	1	1.92	−1.1
Macedonia, FYR	MK	2	0.96	2	0.96	−0.2
Malta	MT	1	2.43	1	2.42	−0.3
Moldova[a]	MD	0	0.00	N/A	N/A	N/A
Montenegro	ME	1	1.53	1	1.54	0.5
Morocco	MA	5	0.15	7	0.21	36.5
Netherlands	NL	57	3.39	31	1.84	−45.8
Norway	NO	9	1.77	10	1.94	9.8
Poland	PL	25	0.65	35	0.91	40.1
Portugal	PT	26	2.41	24	2.22	−7.8
Romania	RO	17	0.78	12	0.55	−29.2
Russian Federation	RU	42	0.29	42	0.29	0.0
San Marino[a]	SM	1	30.82	N/A	N/A	N/A
Serbia	RS	6	0.83	6	0.83	0.5
Slovakia	SK	5	0.91	6	1.09	19.9
Slovenia	SI	2	1.00	2	1.01	0.2
Spain	ES	130	2.74	130	2.72	−0.8
Sweden	SE	N/A	N/A	15	1.54	N/A
Switzerland	CH	31	3.88	48	5.95	53.6
Syria[a]	SY	N/A	N/A	N/A	N/A	N/A
Tunisia	TN	N/A	N/A	8	0.73	N/A
Turkey[a]	TR	N/A	N/A	N/A	N/A	N/A
Ukraine	UA	13	0.29	9	0.20	−30.3
United Kingdom	GB	109	1.72	129	2.02	17.7

[a]These five countries did not submit data on CRT implantation centres for the EHRA White Book 2015.

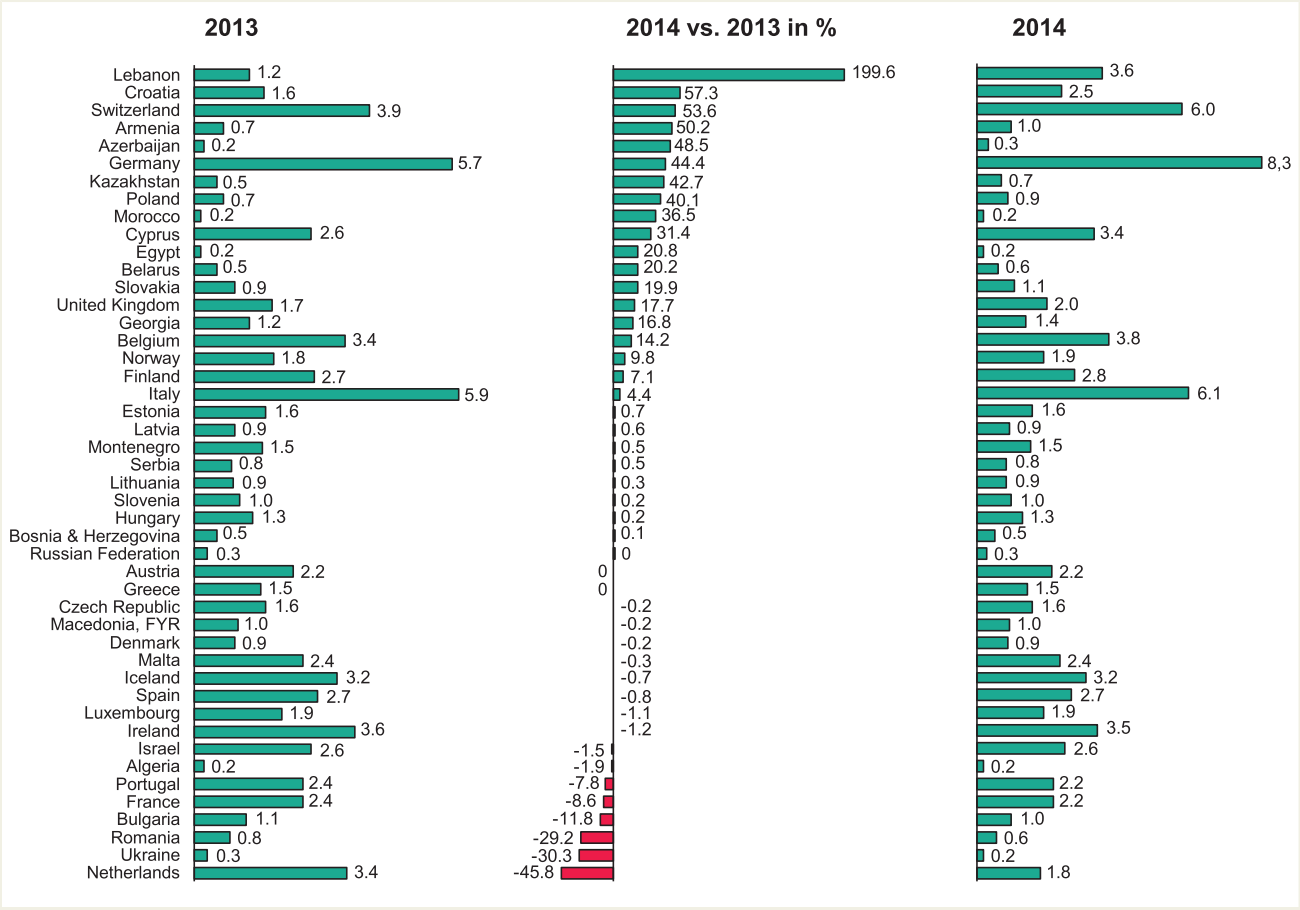

Figure 49 Change in the number of CRT implanting centres per million inhabitants from 2013 to 2014.

Discussion

The EHRA White Book has played a key role in the ICD for life programme[12] and many other strategic initiatives and awareness activities of the EHRA. This comparative analysis of the EHRA White Book data indicates that considerable variations in the use of invasive electrophysiological procedures still exist between the ESC member countries. While improvements have been made over the 5-year period from 2010 to 2014, there is still a clear need to continue to advance. As in previous years, the mean CIED implantation rates were markedly lower in the Eastern European and non-European ESC countries than in the other regions. Also the catheter ablation activity was substantially higher in the Western and Northern European than in the non-European ESC countries. The Eastern European ESC countries were characterized by large variations in the procedure rates, with numbers spanning over all four quartiles of the activity distribution.

Potential for improvement

There was a large gap between the EU28 countries and selected Eastern European and non-European ESC countries in the CIED implantation facilities and rates. Likewise, catheter ablation facilities and rates were markedly lower in the non-European than in the European ESC member countries. National data on health expenditures and CIED implantation rate per capita indicate that a low proportion of healthcare expenditure is associated with a lower use of device therapy and the use of complex interventional EP procedures (*Figure 83*). However, in some Eastern European countries with relatively low GDP, device implantation and catheter ablation rates per million population exceed those of certain Western and Northern European countries. Furthermore, the number of hospitals and beds was not directly related to the financial profile or healthcare expenditure of a given country. This indicates that a high GDP may not be the only requirement for an active programme in expensive arrhythmia care. Other potential explanations for the observed disparity include the lack of manpower, training opportunities, facilities, and low referral rates.[13] It should be noted, nevertheless, that despite the ongoing economic difficulties all across Europe, the use of device and catheter ablation therapies is growing in a number of countries with relative low GDP and in many cases the growth rate exceeds that of some the Western and Northern European countries. On the other hand, in many Western and Northern European countries, the use of device and ablation therapies has remained stable or even declined slightly. It is unclear whether this is a consequence of

Table 13 Change in the number of total CRT device implantations in year 2013 vs. 2014

Country	ISO code	Total CRT implantations 2013		Total CRT implantations 2014		Change %
		Absolute number	Per mil inhabitants	Absolute number	Per mil inhabitants	
Albania	AL	N/A	N/A	2	0.66	N/A
Algeria	DZ	64	1.68	56	1.44	−14.1
Armenia	AM	10	3.26	4	1.31	−60.0
Austria	AT	1178	143.28	1236	150.31	4.9
Azerbaijan	AZ	17	1.77	18	1.86	4.8
Belarus	BY	54	5.61	49	5.10	−9.1
Belgium	BE	1221	116.91	1332	127.47	9.0
Bosnia & Herzegovina	BA	25	6.45	23	5.94	−7.9
Bulgaria	BG	260	37.24	303	43.76	17.5
Croatia	HR	81	18.10	124	27.74	53.3
Cyprus	CY	25	21.64	29	24.73	14.3
Czech Republic	CZ	1716	161.74	1872	176.15	8.9
Denmark	DK	1001	180.15	965	173.28	−3.8
Egypt	EG	414	4.85	530	6.10	25.7
Estonia	EE	70	55.28	51	40.54	−26.7
Finland	FI	437	82.98	526	99.83	20.3
France	FR	N/A	N/A	9570	144.43	N/A
Georgia	GE	40	8.09	55	11.14	37.7
Germany	DE	8859	109.17	19 589	241.85	121.5
Greece	GR	500	46.41	580	53.83	16.0
Hungary	HU	984	99.00	941	94.87	−4.2
Iceland	IS	14	44.40	26	81.93	84.5
Ireland[a]	IE	378	79.15	N/A	N/A	N/A
Israel	IL	1216	157.78	1330	170.04	7.8
Italy	IT	12 148	197.59	12 336	200.00	1.2
Kazakhstan	KZ	209	11.78	262	14.60	23.9
Kosovo	XK	N/A	N/A	0	0.00	N/A
Kyrgyzstan	KGZ	N/A	N/A	0	0.00	N/A
Latvia	LV	63	28.92	105	48.50	67.7
Lebanon	LB	100	24.20	160	38.68	59.8
Libya[a]	LY	N/A	N/A	N/A	N/A	N/A
Lithuania	LT	165	46.93	192	54.77	16.7
Luxembourg	LU	22	42.73	34	65.30	52.8
Macedonia, FYR	MK	16	7.67	28	13.39	74.6
Malta	MT	16	38.90	48	116.32	199.0
Moldova[a]	MD	0	0.00	N/A	N/A	N/A
Montenegro	ME	10	15.30	22	33.84	121.2
Morocco	MA	75	2.30	62	1.85	−19.4
Netherlands	NL	2069	123.12	1931	114.41	−7.1
Norway	NO	426	83.77	514	99.85	19.2
Poland	PL	3000	78.16	3718	96.96	24.1
Portugal	PT	N/A	N/A	696	64.36	N/A
Romania	RO	200	9.18	289	13.30	44.9
Russian Federation	RU	1012	7.10	863	6.06	−14.7
San Marino[a]	SM	0	0.00	N/A	N/A	N/A
Serbia	RS	329	45.42	321	44.52	−2.0
Slovakia	SK	452	82.36	529	96.31	16.9
Slovenia	SI	131	65.74	150	75.44	14.8
Spain	ES	2545	53.73	2974	62.30	16.0
Sweden	SE	967	100.23	854	87.83	−12.4
Switzerland	CH	477	59.65	583	72.32	21.2
Syria[a]	SY	N/A	N/A	N/A	N/A	N/A
Tunisia	TN	N/A	N/A	180	16.46	N/A
Turkey	TR	N/A	N/A	2460	30.14	N/A
Ukraine	UA	89	2.00	85	1.92	−3.9
United Kingdom	GB	7762	122.44	9516	149.29	21.9

[a]These five countries did not submit data on CRT implantations for the EHRA White Book 2015.

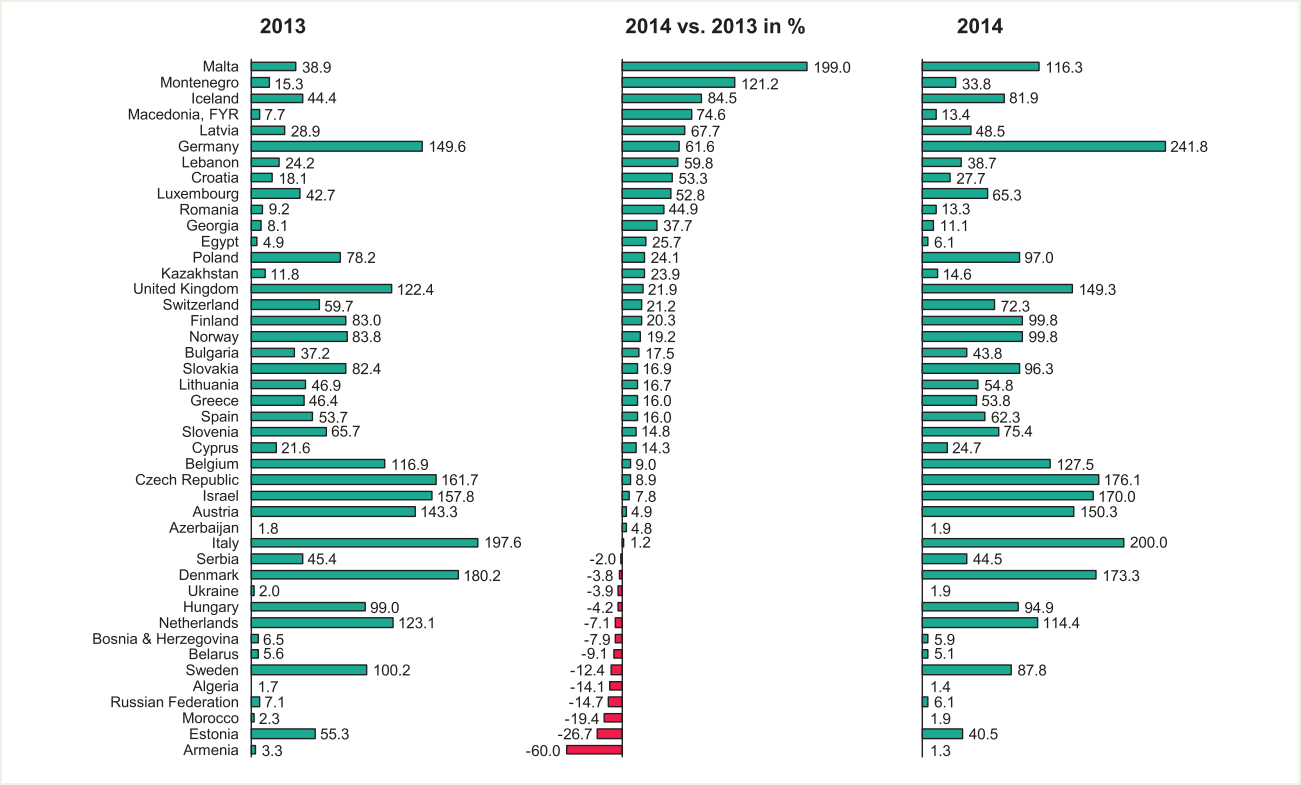

Figure 50 Change in the number of CRT implantations per million inhabitants from 2013 to 2014.

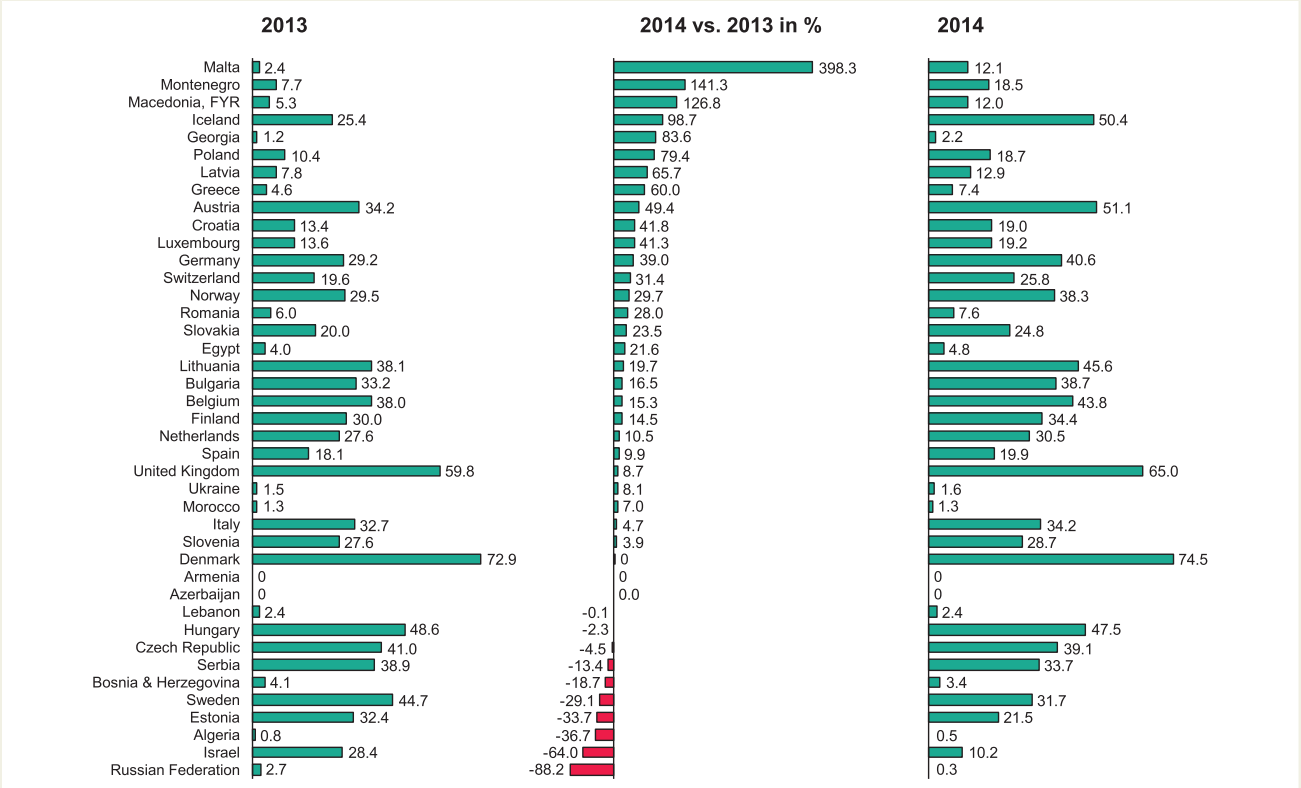

Figure 51 Change in the number of CRT-P implantations per million inhabitants from 2013 to 2014.

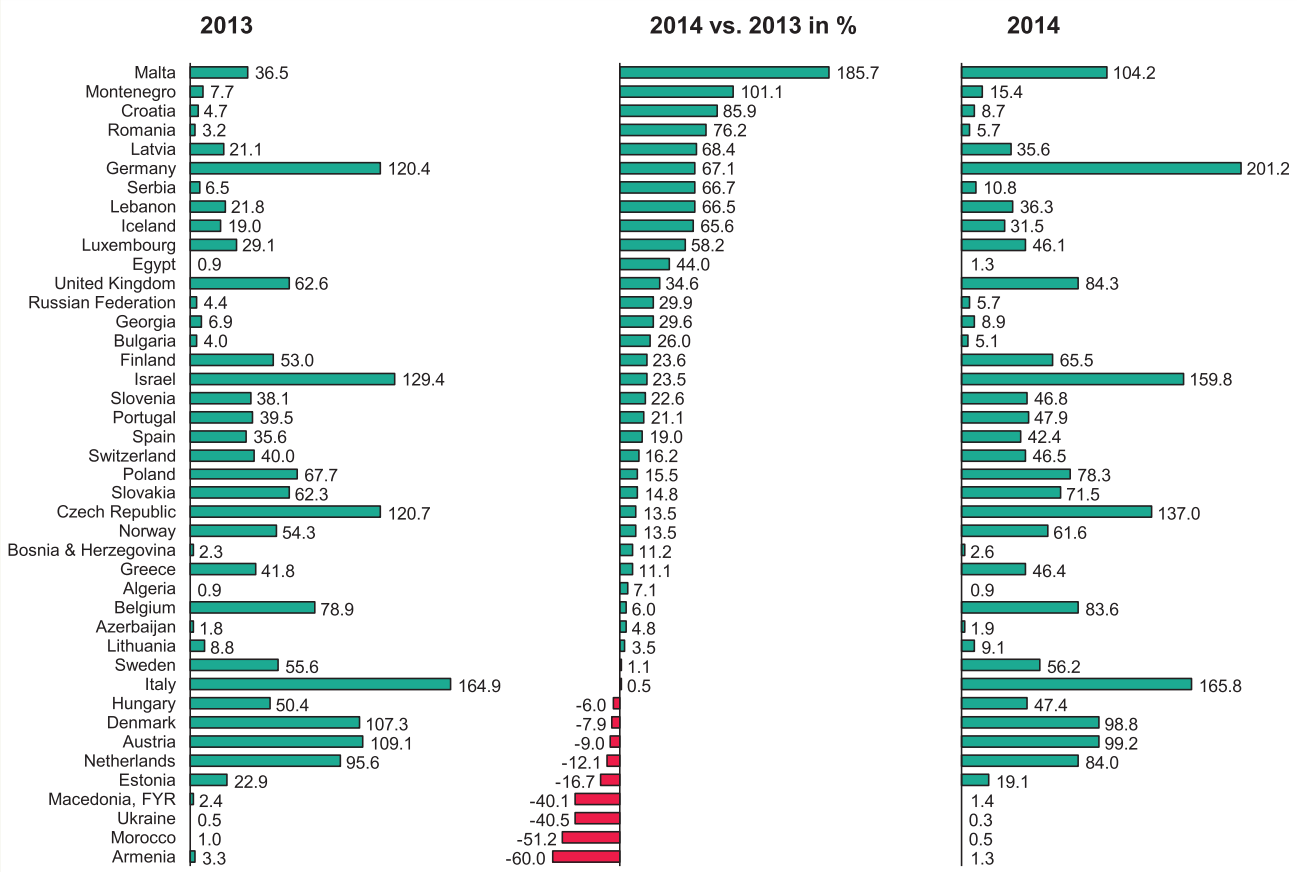

Figure 52 Change in the number of CRT-D implantations per million inhabitants from 2013 to 2014.

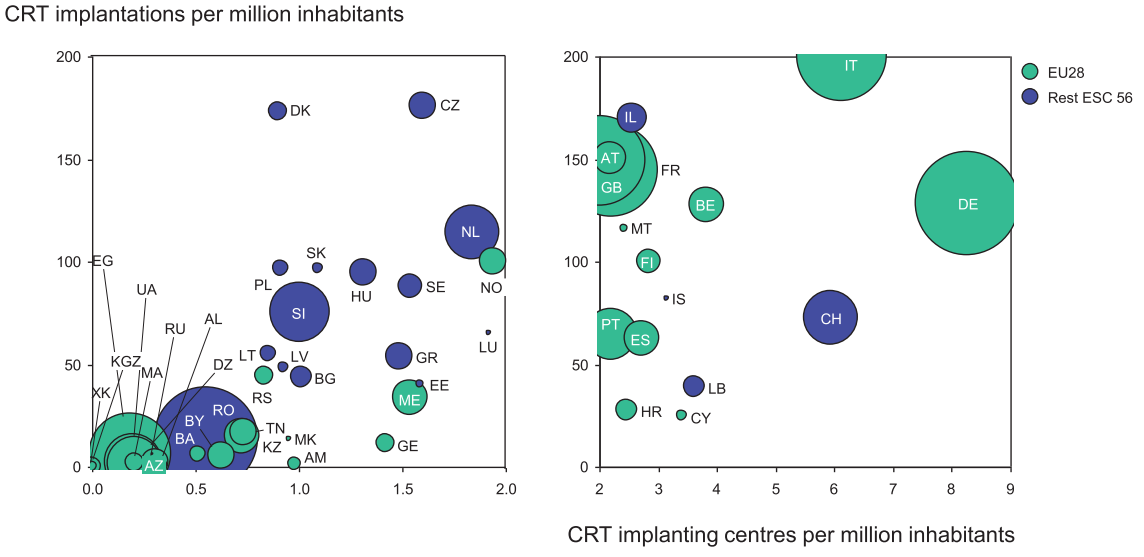

Figure 53 Cardiac resynchronization therapy implantation centres and rates in the ESC and European Union (EU28) member countries in 2014. Bubble size is related to population in the country. The ISO codes of the countries are explained in *Table 1*.

Table 14 Lead extraction facilities and rates in 2014 and comparison to the previous years

Country	ISO code	Number of LE centres 2014		Number of LE procedures 2014		Development potential—target number of LE procedures		LE procedures per mil inhabitants		
		Absolute number	Per mil inhabitants	Absolute number	Per mil inhabitants	To attain mean ESC area level	To attain mean EU28 level	2012	2013	2014
Albania[a]	AL	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Algeria	DZ	2	0.05	56	1.44	597	1222	N/A	N/A	1
Armenia	AM	0	0.00	0	0.00	47	96	0	1	0
Austria	AT	5	0.61	280	34.05	–	–	27	30	34
Azerbaijan	AZ	1	0.10	8	0.83	149	305	N/A	1	1
Belarus	BY	10	1.04	6	0.62	148	303	4	N/A	1
Belgium[a]	BE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Bosnia & Herzegovina	BA	0	0.00	0	0.00	60	122	N/A	0	0
Bulgaria	BG	0	0.00	0	0.00	106	218	N/A	2	0
Croatia	HR	6	1.34	31	6.93	69	141	2	0	7
Cyprus	CY	1	0.85	3	2.56	18	37	0	2	3
Czech Republic	CZ	5	0.47	180	16.94	–	335	29	30	17
Denmark[b]	DK	4	0.72	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Egypt	EG	4	0.05	28	0.32	1336	2736	0	0	0
Estonia[a]	EE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Finland	FI	5	0.95	17	3.23	81	166	N/A	N/A	3
France	FR	50	0.75	2200	33.20	–	–	30	N/A	33
Georgia	GE	1	0.20	3	0.61	76	155	N/A	0	1
Germany	DE	560	6.91	4963	61.27	–	–	10	N/A	61
Greece	GR	4	0.37	50	4.64	166	339	2	3	5
Hungary	HU	8	0.81	97	9.78	153	312	7	13	10
Iceland	IS	1	3.15	1	3.15	5	10	0	0	3
Ireland[b]	IE	2	0.41	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Israel	IL	5	0.64	80	10.23	120	246	0	N/A	10
Italy[a]	IT	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Kazakhstan	KZ	0	0.00	0	0.00	276	565	0	N/A	0
Kosovo	XK	0	0.00	0	0.00	29	59	N/A	N/A	0
Kyrgyzstan[a]	KGZ	N/A	N/A	N/A	N/A	N/A	N/A	0	N/A	N/A
Latvia	LV	1	0.46	10	4.62	33	68	3	4	5
Lebanon[b]	LB	5	1.21	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Libya[a]	LY	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Lithuania	LT	2	0.57	12	3.42	54	110	3	3	3
Luxembourg	LU	1	1.92	7	13.44	8	16	18	N/A	13
Macedonia, FYR	MK	2	0.96	0	0.00	32	66	3	0	0
Malta	MT	1	2.42	7	16.96	–	13	0	0	17
Moldova[a]	MD	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1	N/A
Montenegro	ME	0	0.00	0	0.00	10	20	0	0	0
Morocco	MA	2	0.06	10	0.30	515	1054	0	0	0
Netherlands	NL	12	0.71	500	29.63	–	531	N/A	24	30
Norway	NO	3	0.58	219	42.54	–	–	36	42	43
Poland	PL	10	0.26	600	15.65	–	1207	14	12	16
Portugal[b]	PT	5	0.46	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Romania	RO	2	0.09	10	0.46	334	684	0	0	0
Russian Federation[a]	RU	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
San Marino[a]	SM	N/A	N/A	N/A	N/A	N/A	N/A	0	0	N/A
Serbia	RS	5	0.69	62	8.60	111	227	7	5	9
Slovakia	SK	3	0.55	136	24.76	–	173	25	20	25
Slovenia[a]	SI	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Spain[b]	ES	16	0.34	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Continued

Table 14 *Continued*

Country	ISO code	Number of LE centres 2014		Number of LE procedures 2014		Development potential—target number of LE procedures		LE procedures per mil inhabitants		
		Absolute number	Per mil inhabitants	Absolute number	Per mil inhabitants	To attain mean ESC area level	To attain mean EU28 level	2012	2013	2014
Sweden	SE	5	0.51	450	46.28	–	–	22	51	46
Switzerland	CH	5	0.62	87	10.79	124	254	N/A	11	11
Syria[a]	SY	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tunisia	TN	3	0.27	20	1.83	168	344	7	N/A	2
Turkey	TR	N/A	N/A	311	3.81	1255	2570	N/A	N/A	4
Ukraine	UA	7	0.16	38	0.86	681	1395	1	1	1
United Kingdom[a]	GB	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total ESC countries	56	764		10 482						

[a]These 12 countries did not submit data on LEs.
[b]These four countries gave only the number of LE centres for the EHRA White Book 2015.

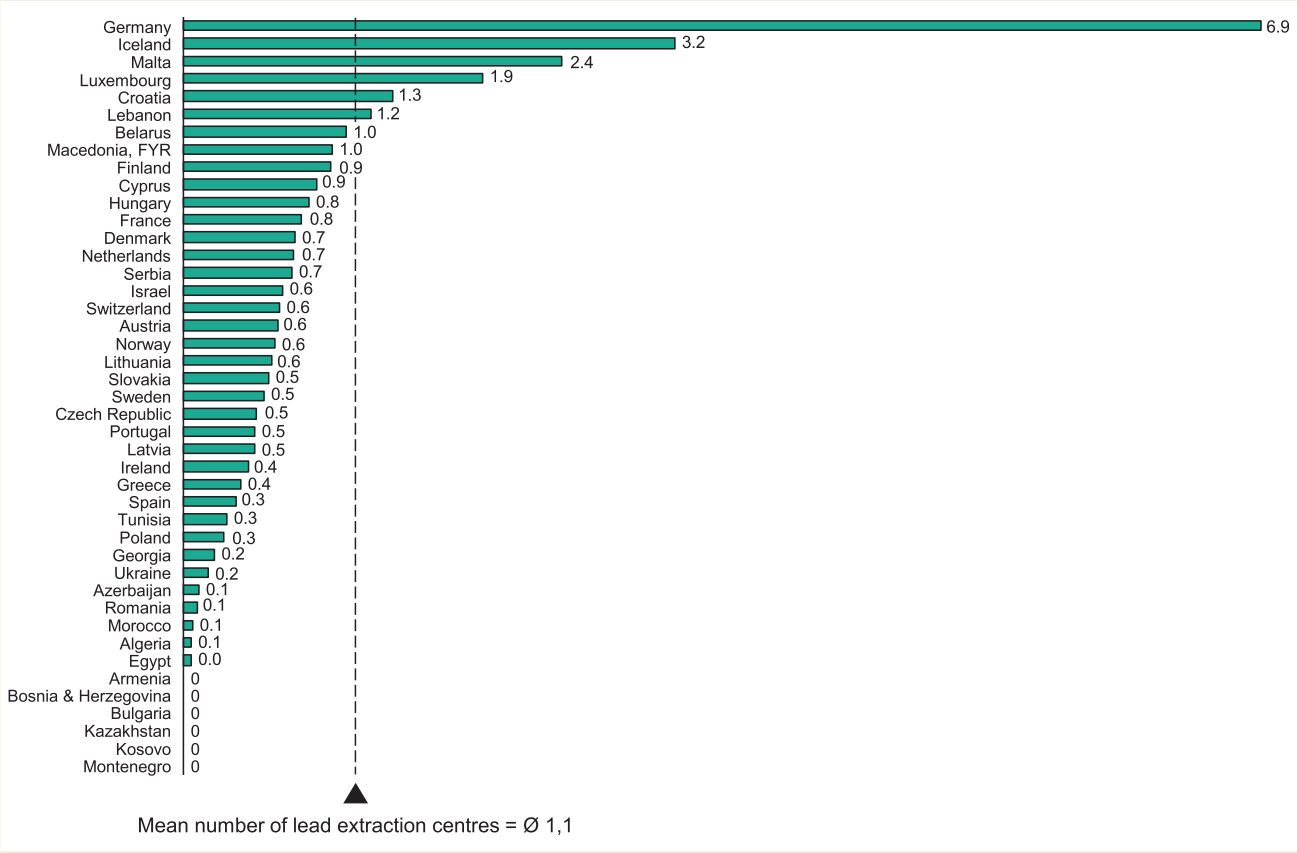

Figure 54 Lead extraction centres per million inhabitants in 2014. The mean number of LE centres is weighted by population.

constraints on healthcare expenditure in the wake of the financial crisis or that supply is already meeting demand or both.

In recent years, a major limitation for further improvements in arrhythmia management across the ESC area has been the poor economic situation. Owing to the ongoing financial problems, many countries have made substantial budget cuts for healthcare.[14–16] At the same time, the number of elderly requiring vast medical and social assistance has grown rapidly. In this context,

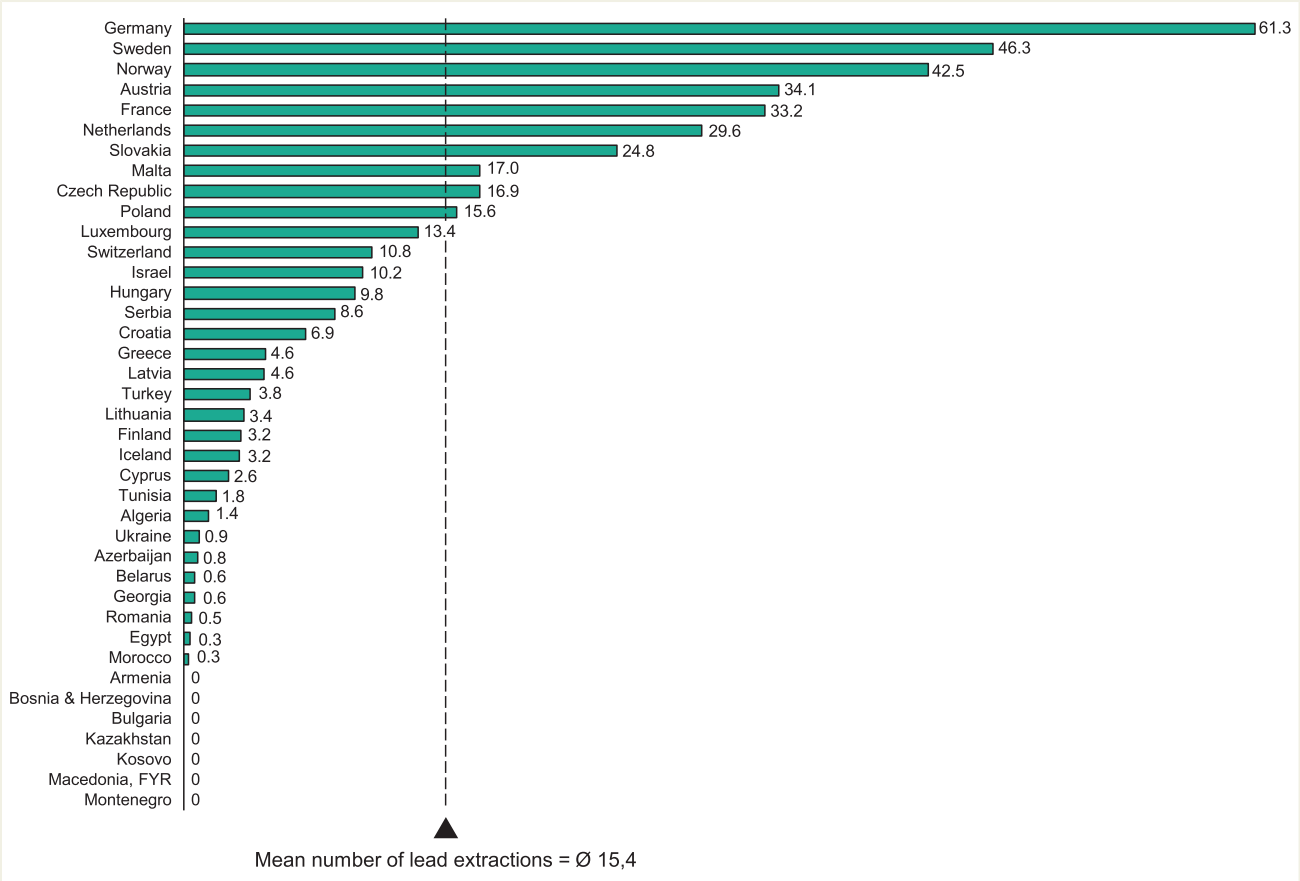

Figure 55 Lead extractions per million inhabitants in 2014. The mean number of LEs is weighted by population.

socioeconomic disparities pose major threats to healthcare systems, and may limit the use of expensive innovative technologies such as ICD therapy for primary prevention of sudden cardiac death (SCD) and catheter ablation of AF.[14–17]

Evolving areas in cardiac rhythm management therapy

Given the growing number of ICD patients, the need for catheter ablations in patients with structural heart disease is expected to grow in the future. Several studies have shown that ICD prevents SCD not only in patients who have experienced aborted SCD or VT but also among those with high risk of cardiac arrest due to severe ischaemic or non-ischaemic heart disease or other causes.[18–20] However, although ICD therapy effectively prevents SCD, it has no effect on the underlying mechanism(s), triggers, and occurrence of VT/VF. Traditionally, antiarrhythmic drugs have been the mainstay in this process, but unfortunately they do not provide sufficient protection from recurrent VT/VF and often cause serious adverse events. Radiofrequency catheter ablation has also been successful in treatment of patients receiving multiple ICD shocks,[21] and it may be effective even as prophylactic therapy in selected post-myocardial infarction patients.[22–24]

Another evolving area in cardiac rhythm management is the use of percutaneous LAA occluders to prevent AF-related thrombo-embolic complications.[11] According to a recent meta-analysis, LAA occlusion is non-inferior to warfarin in patients at high risk of thrombo-embolic and bleeding events.[10] At the moment, the procedure numbers in the ESC area except for Germany are quite low, but they are expected to increase in near future.

The rate of LE is also expected to go up. On the basis of reported infections in patients with CIED, it has been estimated that in a country with 1000 CIED implantations per million inhabitants per year, the annual LE activity should be between 15 and 60 procedures per million inhabitants.[7–9] In 2014, the LE activity was within this estimate in 10 countries (Germany, Sweden, Norway, Austria, France, the Netherlands, Slovakia, Malta, the Czech Republic, and Poland). Luxembourg was close to the proposed level (13.4 per million inhabitants), but in most of the others the reported LE rate (0.3–10.8) was considerably smaller than the expected values.

Finally, PM and ICD technology has been developing rapidly during the recent years. Next year we are planning to collect data also on subcutaneous ICD and leadless PM implantation rate.

The role of European Heart Rhythm Association

The disparity in the implementation of arrhythmia treatment and practice guidelines is unfortunately likely to continue, unless there is a continued investment in infrastructure. This includes

Table 15 Catheter ablation facilities and rates in 2014 and comparison to four previous years

Country	ISO code	National registry for EP	Number of ablation centres 2014		Ablation procedures 2014		Development potential—target number of ablation procedures		Ablation procedures per mil inhabitants				
			Absolute number	Per mil inhabitants	Absolute number	Per mil inhabitants	To attain mean ESC area level	To attain mean EU28 level	2010	2011	2012	2013	2014
Albania	AL	No	1	0.33	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Algeria	DZ	No	2	0.05	240	6	9458	15 933	N/A	N/A	N/A	6	6
Armenia	AM	No	3	0.98	132	43	746	1256	17	33	23	46	43
Austria	AT	Yes	17	2.07	2622	319	–	3375	219	220	339	294	319
Azerbaijan	AZ	No	3	0.31	384	40	2360	3976	7	20	N/A	24	40
Belarus	BY	No	6	0.62	807	84	2341	3944	51	61	54	76	84
Belgium	BE	Yes	44	4.21	6126	586	–	–	487	534	564	580	586
Bosnia & Herzegovina	BA	No	0	0.00	0	0	943	1589	3	5	1	0	0
Bulgaria	BG	Yes	4	0.58	663	96	1687	2843	42	39	60	54	96
Croatia	HR	No	5	1.12	852	191	1089	1835	N/A	101	132	183	191
Cyprus	CY	No	3	2.56	142	121	286	481	27	36	35	39	121
Czech Republic	CZ	Yes	22	2.07	5855	551	–	–	428	440	474	482	551
Denmark	DK	Yes	6	1.08	3867	694	–	–	494	457	590	652	694
Egypt	EG	No	15	0.17	1354	16	21 174	35 669	10	N/A	11	12	16
Estonia	EE	No	2	1.59	411	327	–	516	346	300	260	302	327
Finland	FI	No	9	1.71	2222	422	–	–	289	362	415	418	422
France	FR	No	130	1.96	33 300	503	–	–	445	479	472	N/A	503
Georgia	GE	No	7	1.42	356	72	1203	2026	40	55	75	54	72
Germany	DE	No	100	1.23	60 000	741	–	–	514	614	467	412	741
Greece	GR	Yes	29	2.69	1653	153	2626	4423	122	130	131	134	153
Hungary	HU	No	11	1.11	3469	350	–	4072	266	293	314	338	350
Iceland	IS	No	1	3.15	76	239	77	130	227	203	239	254	239
Ireland	IE	No	12	2.48	N/A	N/A	N/A	N/A	173	214	212	209	N/A
Israel	IL	No	16	2.05	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Italy	IT	Yes	N/A	N/A	N/A	N/A	N/A	N/A	N/A	311	N/A	N/A	N/A
Kazakhstan	KZ	No	9	0.50	2018	112	4374	7368	N/A	N/A	57	83	112
Kosovo	XK	No	0	0.00	0	0	453	763	N/A	N/A	N/A	N/A	0
Kyrgyzstan	KGZ	N/A	2	0.36	58	10	1366	2300	N/A	N/A	N/A	N/A	10

Latvia	LV	Yes	2	0.92	638	295	–	889	190	247	269	238	295
Lebanon	LB	No	5	1.21	150	36	1008	1698	N/A	N/A	N/A	24	36
Libya[a]	LY	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Lithuania	LT	No	3	0.86	885	252	–	1439	227	227	243	239	252
Luxembourg	LU	Yes	1	1.92	158	303	–	214	187	252	301	251	303
Macedonia, FYR	MK	No	3	1.43	105	50	510	859	14	26	30	38	50
Malta	MT	Yes	1	2.42	30	73	101	169	32	20	24	29	73
Moldova[a]	MD	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	N/A
Montenegro	ME	No	1	1.54	66	102	158	267	0	11	149	69	102
Morocco	MA	Yes	5	0.15	170	5	8158	13 742	2	3	7	5	5
Netherlands	NL	Yes	16	0.95	8358	495	–	–	341	N/A	382	N/A	495
Norway	NO	No	5	0.97	2959	575	–	–	274	487	530	507	575
Poland	PL	No	83	2.16	10 922	285	–	15 741	199	214	229	248	285
Portugal	PT	Yes	24	2.22	2324	215	2635	4439	152	187	186	191	215
Romania	RO	No	12	0.55	1358	62	5295	8920	46	50	50	60	62
Russian Federation	RU	Yes	81	0.57	23 874	168	34 716	58 482	101	118	120	149	168
San Marino[a]	SM	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	0	0	0	N/A
Serbia	RS	No	2	0.28	815	113	1757	2960	112	125	133	139	113
Slovakia	SK	Yes	4	0.73	1111	202	1338	2255	175	177	168	195	202
Slovenia	SI	Yes	3	1.51	437	220	484	816	131	162	136	140	220
Spain	ES	Yes	85	1.78	12 871	270	–	19 596	188	188	205	253	270
Sweden	SE	Yes	10	1.03	4803	494	–	–	390	450	478	465	494
Switzerland	CH	Yes	23	2.85	5135	637	–	–	514	612	598	566	637
Syria[a]	SY	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tunisia	TN	No	9	0.82	850	78	2665	4490	48	56	47	N/A	78
Turkey	TR	No	N/A	N/A	11 218	137	19 888	33 504	N/A	N/A	N/A	N/A	137
Ukraine	UA	No	8	0.18	2371	54	10 793	18 181	41	47	55	60	54
United Kingdom	GB	Yes	61	0.96	17 578	276	–	26 166	228	240	254	251	276
Total ESC countries	56		906		235 793								

[a]These four countries did not submit data for the EHRA White Book 2015.

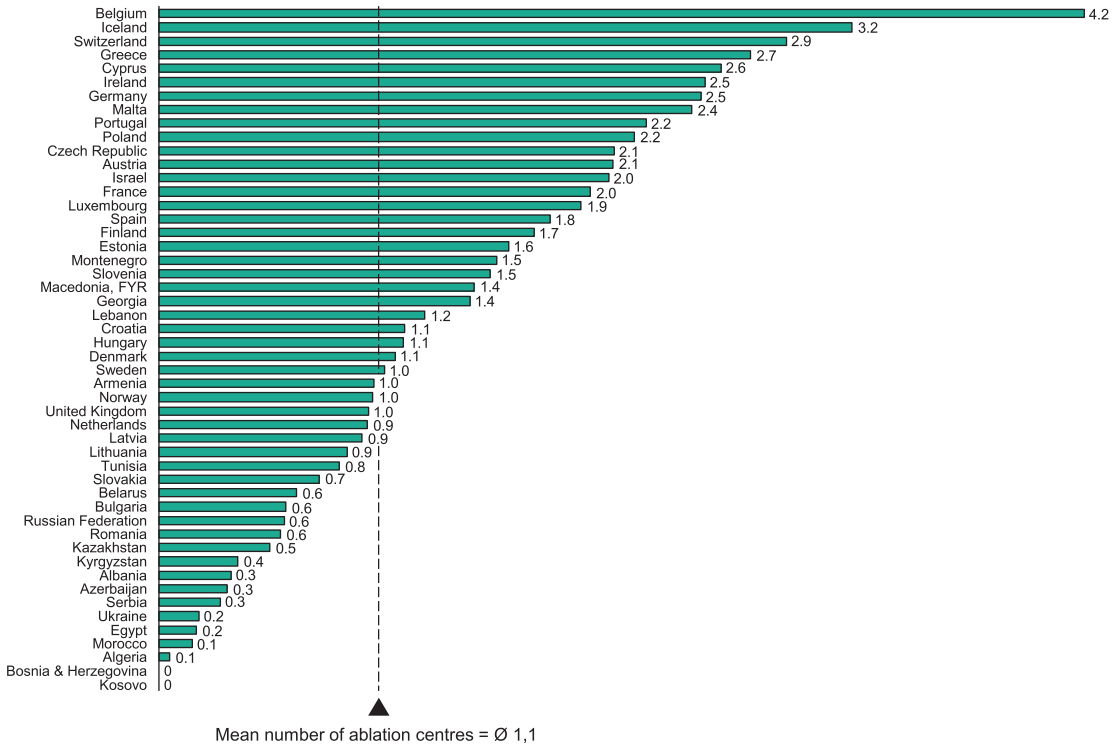

Figure 56 Catheter ablation centres per million inhabitants in 2014. The mean number of catheter ablation centres is weighted by population.

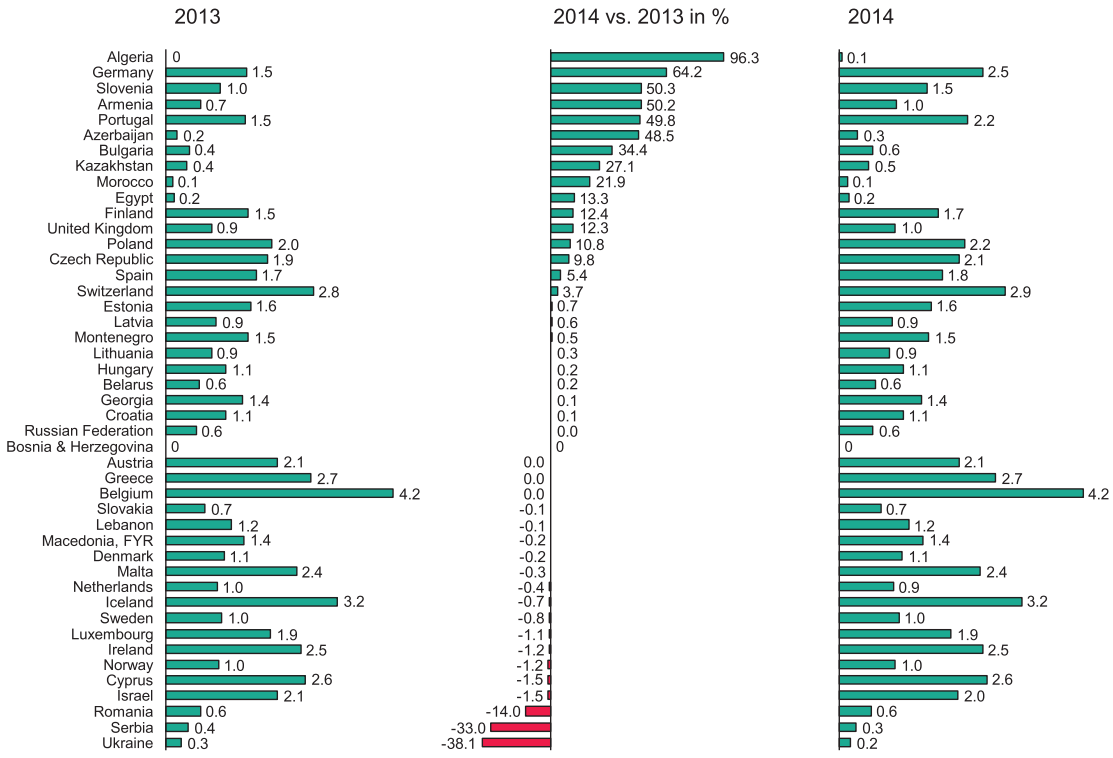

Figure 57 Change in the number of catheter ablation centres per million inhabitants from 2013 to 2014.

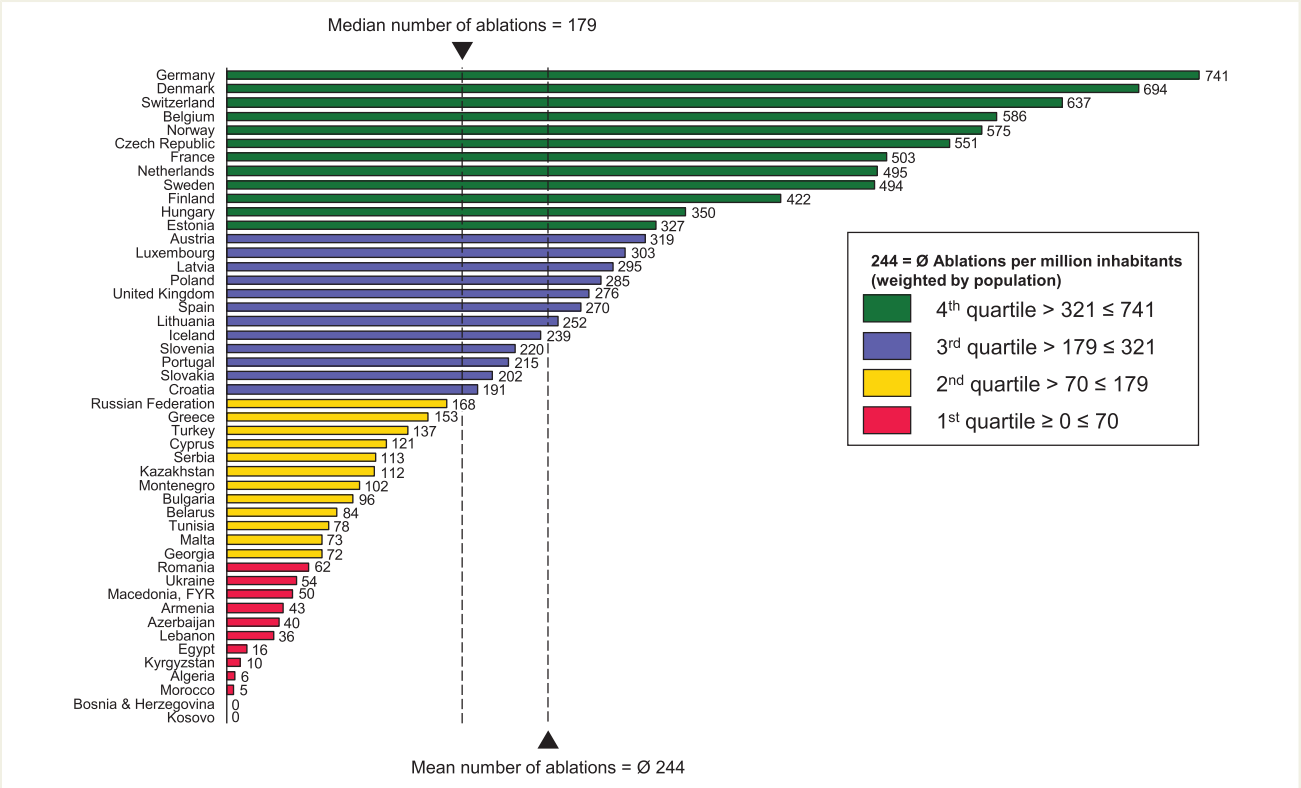

Figure 58 Catheter ablations per million inhabitants in 2014. The mean number of ablations is weighted by population.

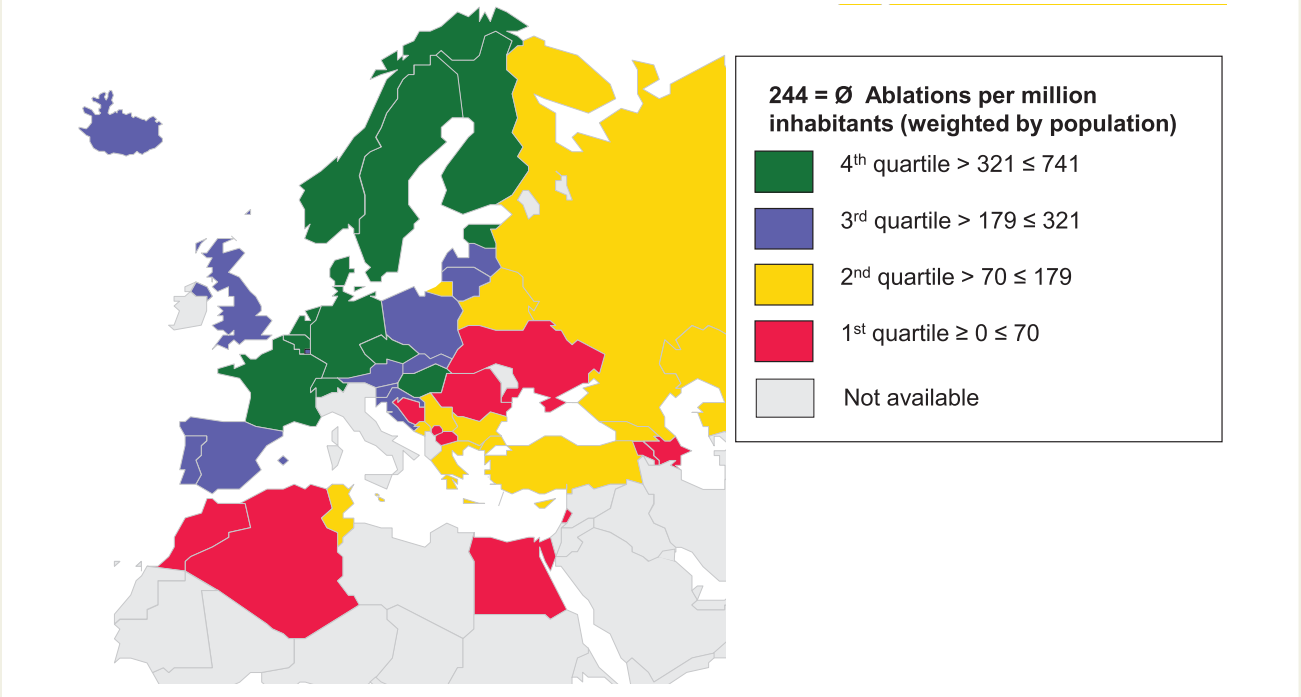

Figure 59 Catheter ablations per million inhabitants in the ESC countries in 2014.

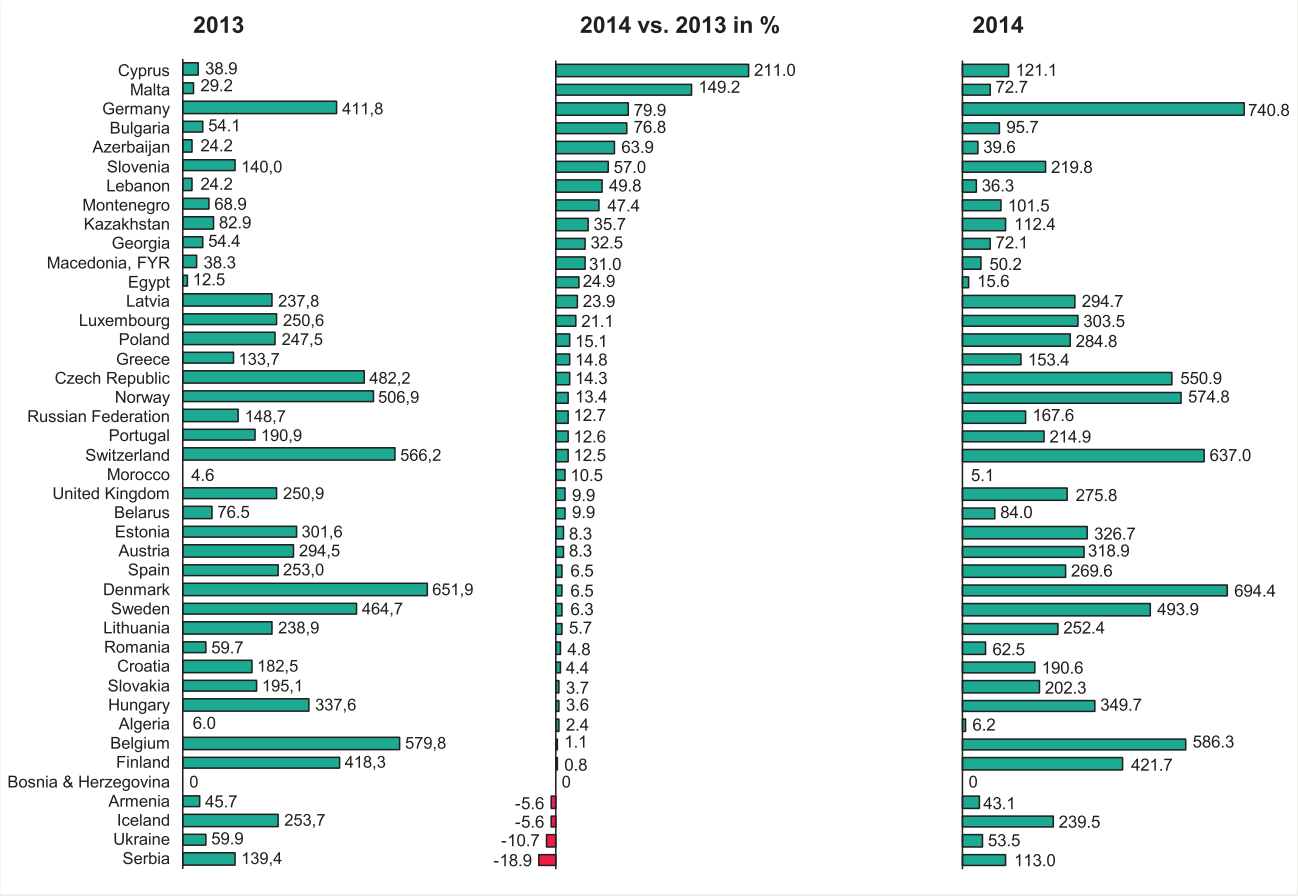

Figure 60 Change in the number of catheter ablations per million inhabitants from 2013 to 2014.

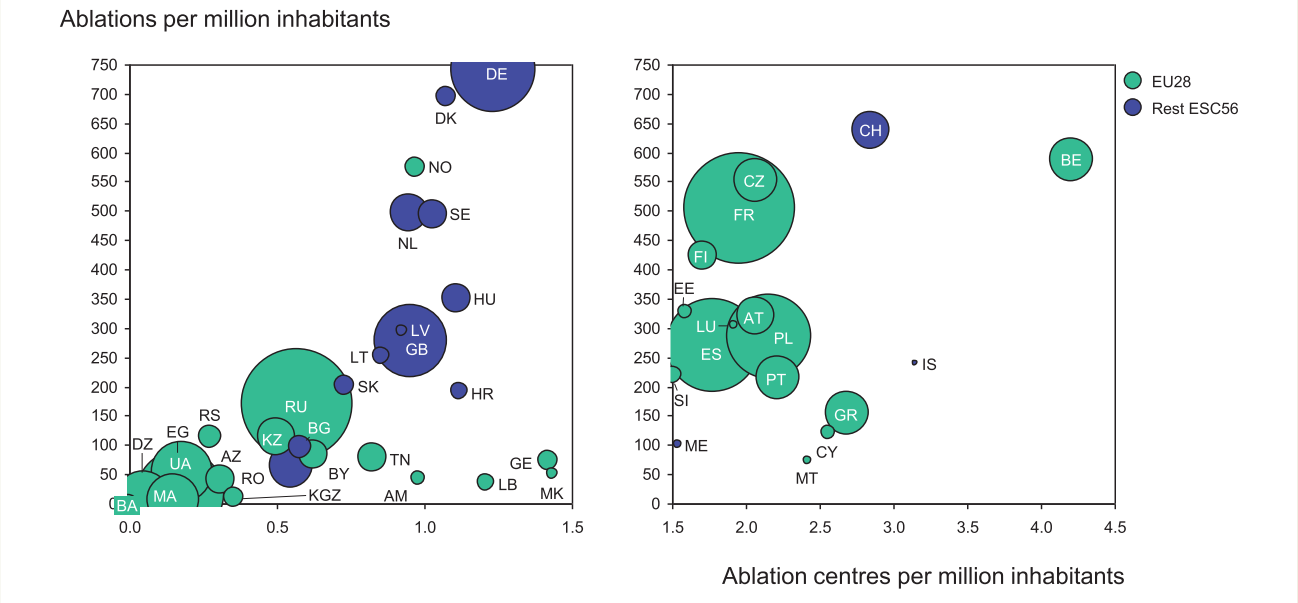

Figure 61 Catheter ablation centres and rates in the ESC and European Union (EU28) member countries in 2014. Bubble size is related to population in the country. The ISO codes of the countries are explained in *Table 1*.

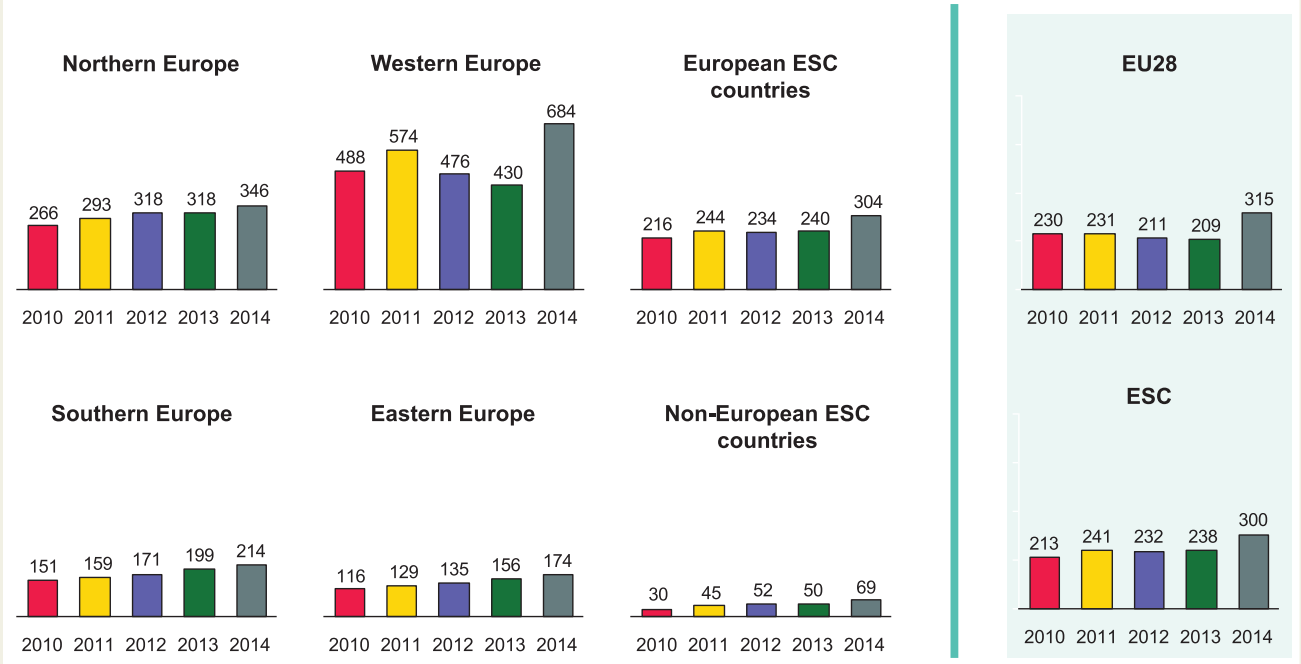

Figure 62 Catheter ablations per million inhabitants 2010–14 in the five geographical regions of the ESC and comparison to the total ESC area and the 28 member countries of the European Union (EU28).

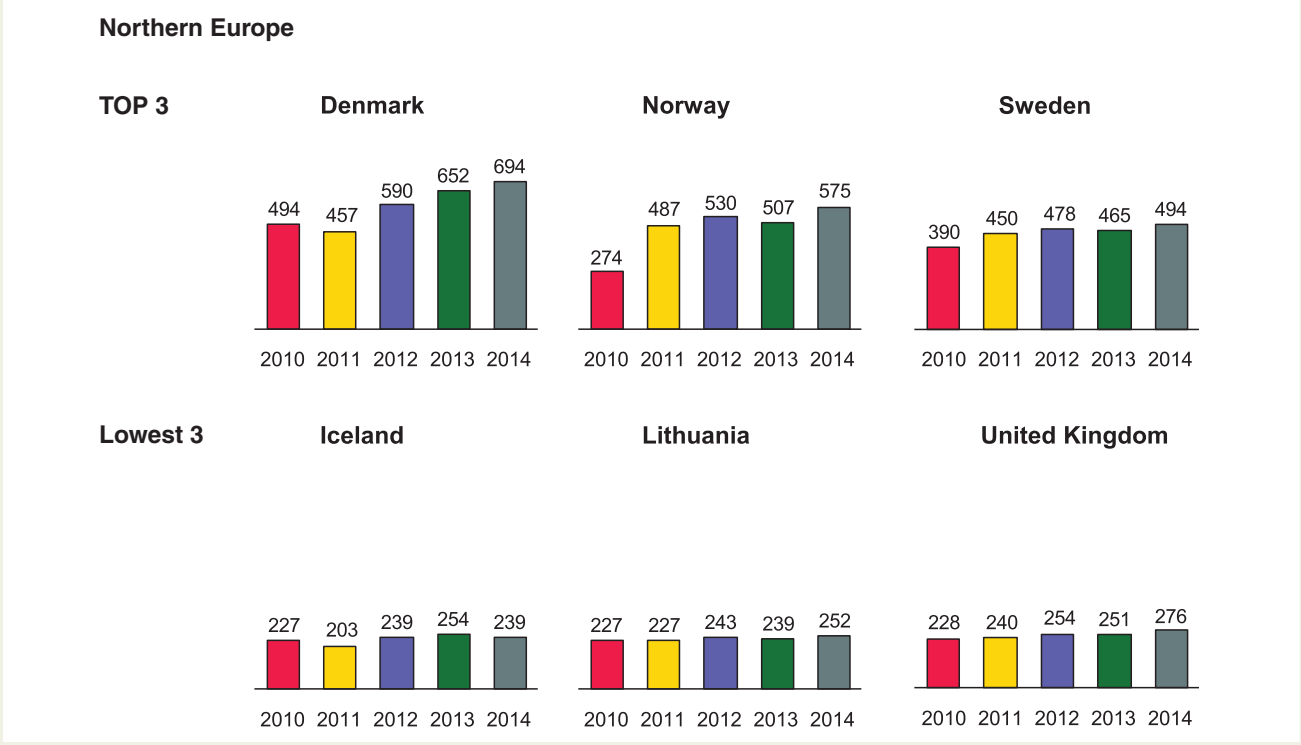

Figure 63 Catheter ablations per million inhabitants 2010–14 in Northern Europe.

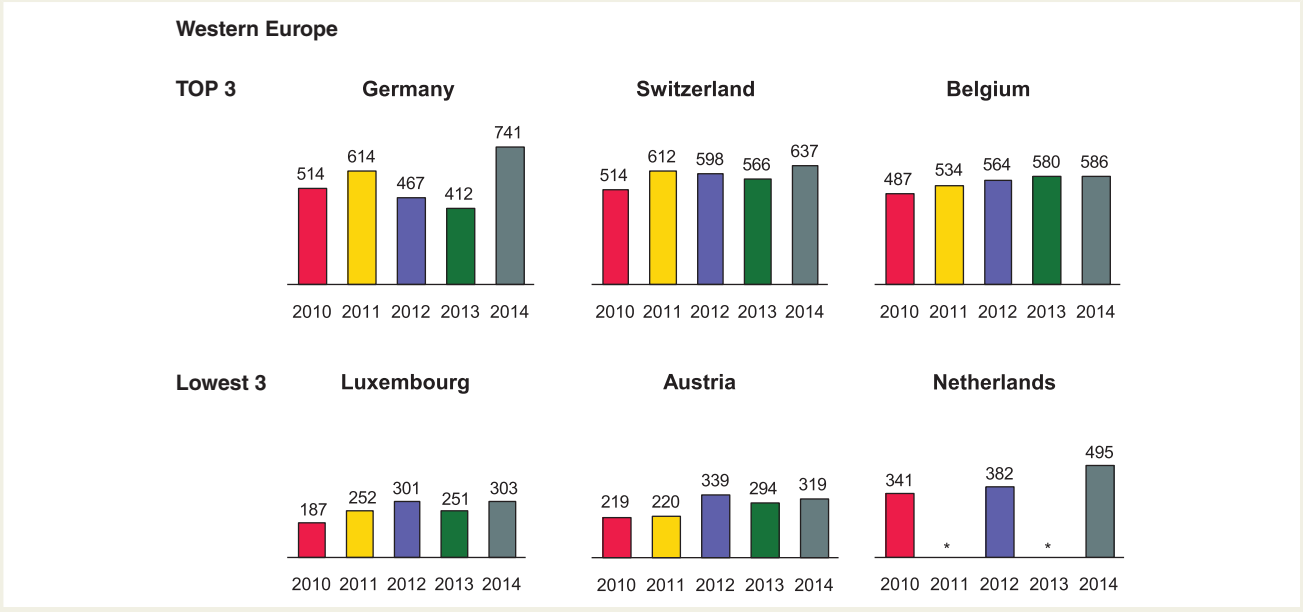

Figure 64 Catheter ablations per million inhabitants 2010–14 in Western Europe. *No data available.

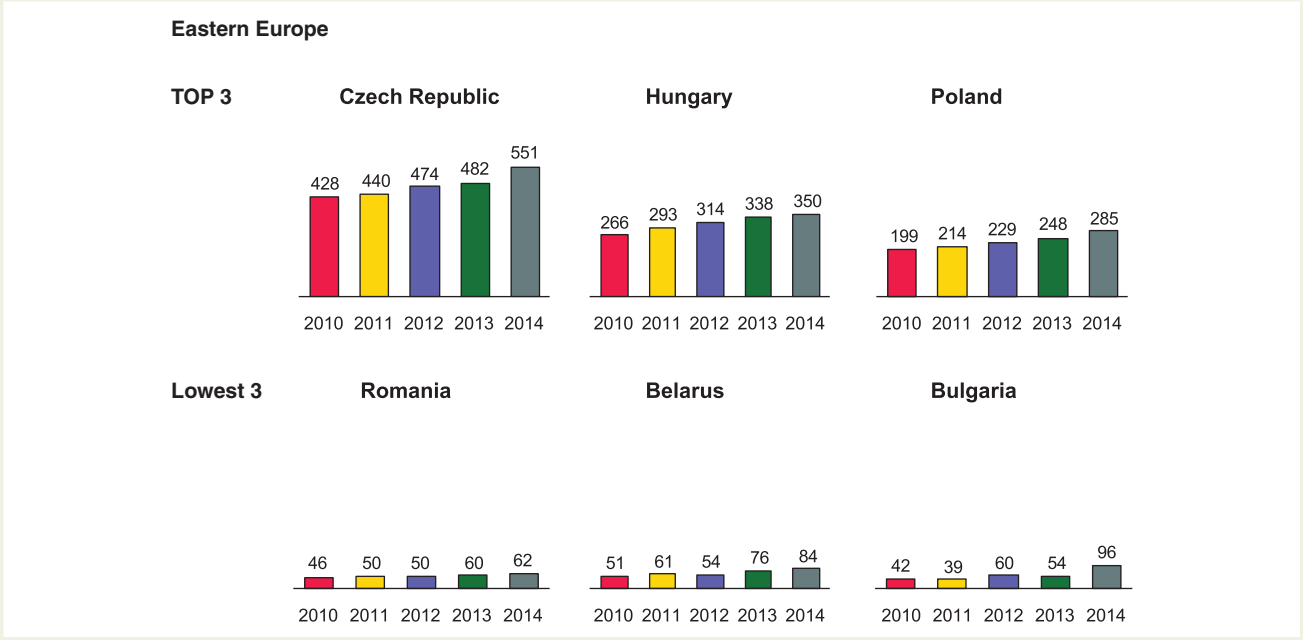

Figure 65 Catheter ablations per million inhabitants 2010–14 in Eastern Europe.

laboratories, specialized equipment, and improved training opportunities. Likewise harmonization of training requirements and implementation of standard clinical practice guidelines are important steps. European Heart Rhythm Association has been very active in promoting unified standards for training of cardiac rhythm management specialists and to assure high quality in arrhythmia care in a broad sense. The ongoing White Book project has revealed disparities in this field also and provided base to improve and align management strategies for arrhythmias across ESC countries.

The EHRA certification programme provides an excellent platform to improve training and the level of arrhythmia care in the ESC area. The introduction of the EHRA accreditation programme for teaching centres will provide further support to standardization of training. European Heart Rhythm Association fellowship grants

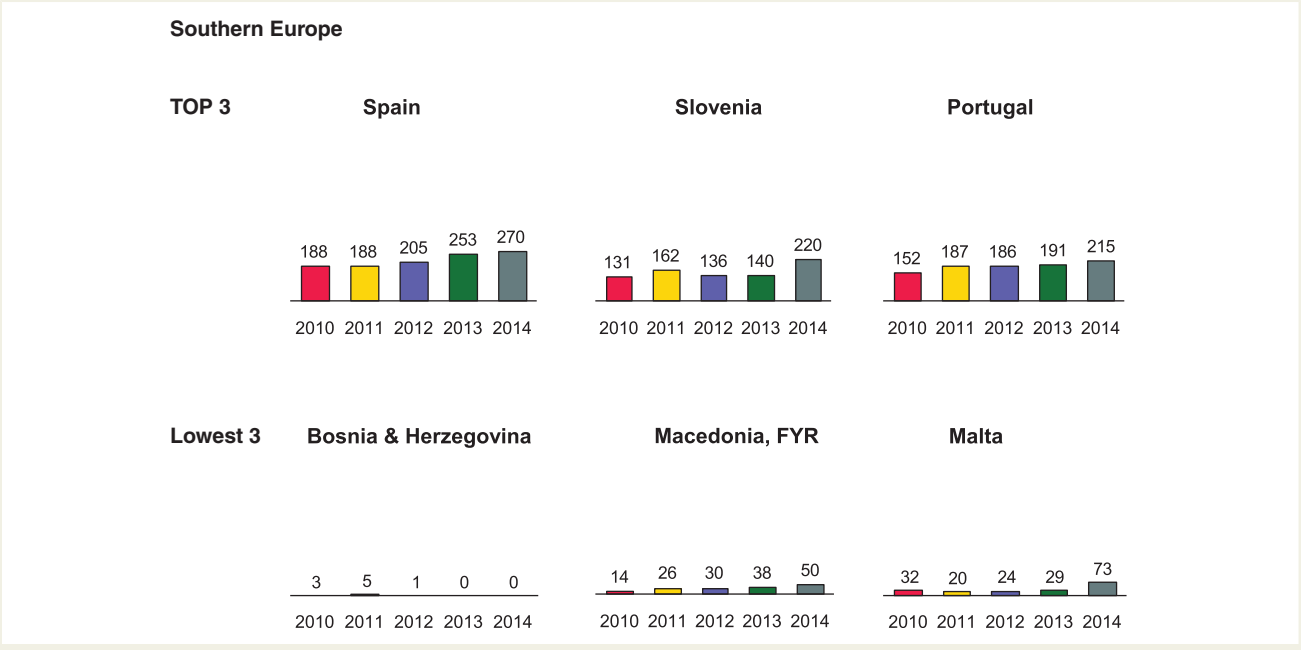

Figure 66 Catheter ablations per million inhabitants 2010–14 in Southern Europe.

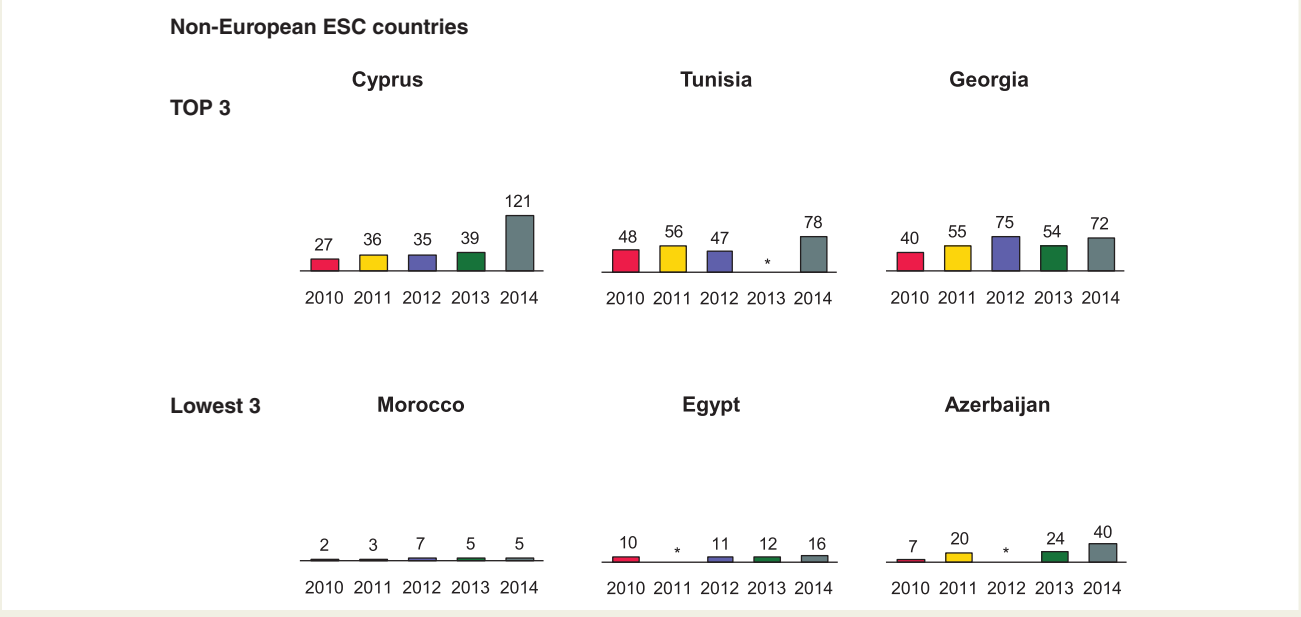

Figure 67 Catheter ablations per million inhabitants 2010–14 in the non-European ESC countries. *No data available.

have already allowed many young physicians from countries with low procedural rates to get training in high-volume centres across the ESC area. The number applications for the EHRA Fellowship grants have been increasing steadily, and the certification programme is now also available for allied professionals. Last year, the EHRA Training Fellowship committee awarded 17 grants for young physicians mainly from emerging economies. In addition, a specific proctor programme was launched in order to provide further training in emerging technologies and complex procedures also to senior physicians.

Limitations

There are several limitations with the methodology of the EHRA White Book data collection. Data collection is exclusively based

Table 16 Atrial fibrillation ablations in 2014 and comparison to four previous years

Country	ISO code	AF Ablation procedures 2014		Development potential—target number of AF ablation procedures		AF ablation procedures per mil inhabitants				
		Absolute number	Per mil inhabitants	To attain mean ESC area level	To attain mean EU28 level	2010	2011	2012	2013	2014
Albania	AL	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Algeria	DZ	0	0	3826	6882	N/A	N/A	N/A	0	0
Armenia	AM	11	4	302	543	1	1	3	3	4
Austria	AT	878	107	–	1458	55	62	122	94	107
Azerbaijan	AZ	2	0	955	1717	0	0	N/A	0	0
Belarus	BY	69	7	947	1704	6	4	6	7	7
Belgium	BE	2560	245	–	–	176	182	224	225	245
Bosnia & Herzegovina	BA	0	0	382	686	0	0	0	0	0
Bulgaria	BG	79	11	683	1228	2	0	7	7	11
Croatia	HR	223	50	441	793	0	10	18	38	50
Cyprus	CY	53	45	116	208	0	3	5	5	45
Czech Republic	CZ	2297	216	–	–	119	156	177	196	216
Denmark	DK	1698	305	–	–	234	194	262	290	305
Egypt	EG	60	1	8565	15 407	0	N/A	0	0	1
Estonia	EE	98	78	124	223	87	90	27	56	78
Finland	FI	736	140	–	934	74	91	110	124	140
France	FR	11 000	166	–	11 748	114	100	130	N/A	166
Georgia	GE	50	10	487	875	10	9	11	7	10
Germany	DE	40 000	494	–	–	147	184	172	144	494
Greece	GR	560	52	1062	1911	23	32	37	40	52
Hungary	HU	1081	109	–	1759	49	61	75	86	109
Iceland	IS	33	104	–	56	42	48	77	73	104
Ireland	IE	N/A	N/A	N/A	N/A	76	96	95	94	N/A
Israel	IL	550	70	771	1387	N/A	N/A	0	N/A	70
Italy	IT	N/A	N/A	N/A	N/A	N/A	N/A	0	N/A	N/A
Kazakhstan	KZ	524	29	1769	3182	N/A	6	11	15	29
Kosovo	XK	0	0	183	330	N/A	N/A	N/A	N/A	0
Kyrgyzstan	KGZ	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Latvia	LV	75	35	213	384	17	31	26	29	35
Lebanon	LB	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Libya[a]	LY	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Lithuania	LT	74	21	346	622	21	19	8	9	21
Luxembourg	LU	57	109	–	92	24	54	61	60	109
Macedonia, FYR	MK	0	0	206	371	0	0	0	0	0
Malta	MT	0	0	41	73	0	0	0	2	0
Moldova[a]	MD	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	N/A
Montenegro	ME	17	26	64	115	0	0	0	0	26
Morocco	MA	N/A	N/A	N/A	N/A	0	0	0	N/A	N/A
Netherlands	NL	3413	202	–	–	128	N/A	156	N/A	202
Norway	NO	1432	278	–	–	89	242	249	293	278
Poland	PL	2169	57	3780	6799	31	N/A	44	50	57
Portugal	PT	684	63	1066	1917	33	43	49	51	63
Romania	RO	88	4	2142	3853	1	3	4	6	4
Russian Federation	RU	6462	45	14 043	25 261	22	27	27	41	45
San Marino[a]	SM	N/A	N/A	N/A	N/A	0	0	0	0	N/A
Serbia	RS	236	33	711	1278	7	8	14	17	33
Slovakia	SK	129	23	541	974	24	17	18	27	23
Slovenia	SI	149	75	196	353	45	59	55	83	75

Continued

Table 16 ***Continued***

Country	ISO code	AF Ablation procedures 2014		Development potential—target number of AF ablation procedures		AF ablation procedures per mil inhabitants				
		Absolute number	Per mil inhabitants	To attain mean ESC area level	To attain mean EU28 level	2010	2011	2012	2013	2014
Spain	ES	2498	52	4706	8464	28	31	33	46	52
Sweden	SE	1791	184	–	–	126	157	178	179	184
Switzerland	CH	1684	209	–	–	166	209	193	184	209
Syria[a]	SY	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tunisia	TN	40	4	1078	1939	2	2	3	N/A	4
Turkey	TR	1208	15	8045	14 471	N/A	N/A	N/A	N/A	15
Ukraine	UA	622	14	4366	7853	9	11	14	15	14
United Kingdom	GB	6505	102	–	11 302	60	74	80	85	102
Total ESC countries	56	91 895								

[a]These four countries did not submit data for the EHRA White Book 2015.

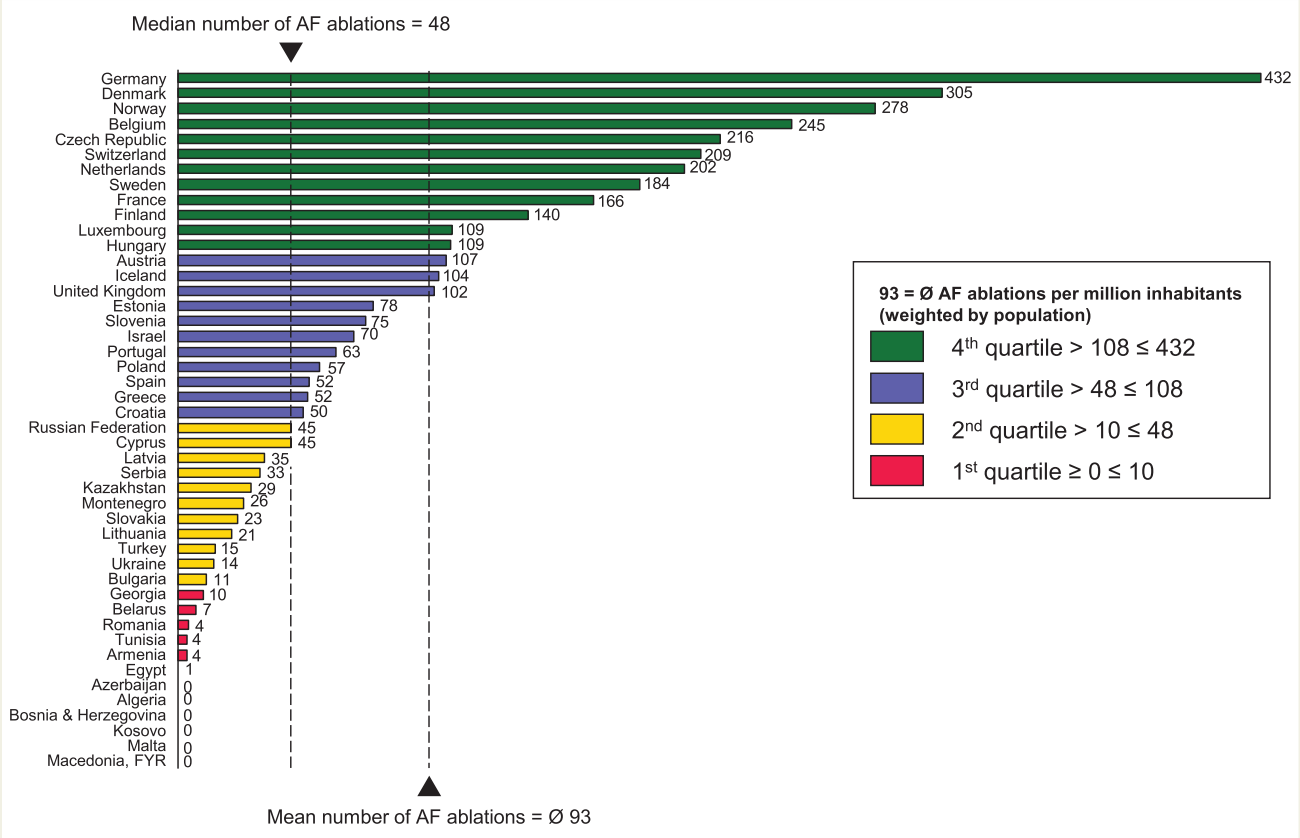

Figure 68 Atrial fibrillation ablations per million inhabitants in 2014. The mean number of AF ablations is weighted by population.

on voluntary activity of the National Cardiac Societies or Arrhythmia Working Groups. The number of countries sharing their data has been steadily increasing. This year 51 of the 56 ESC nations responded to the White Book questionnaire. Some countries, on the other hand, have never reported data for the White Book and many countries do not report complete data. In particular, many countries did not provide data on new therapies such as LE and VT/VF ablations. This may possibly reflect inaccuracies in the collection of data

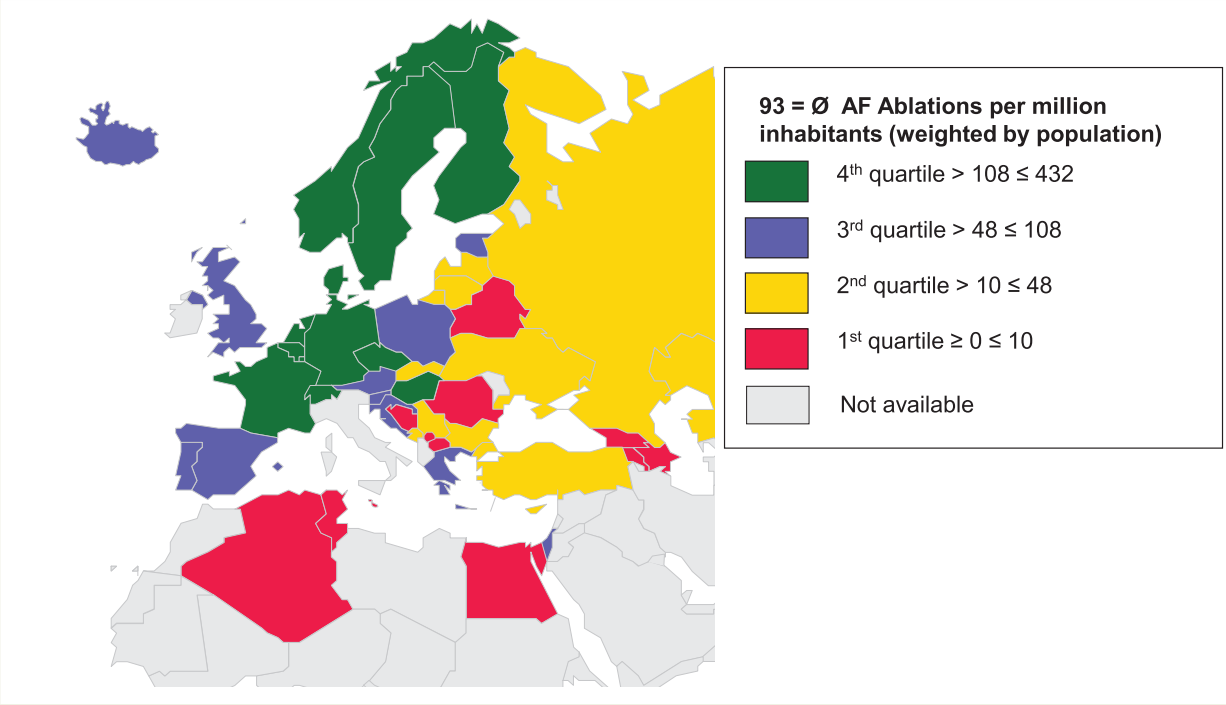

Figure 69 Atrial fibrillation ablations in the ESC countries in 2014.

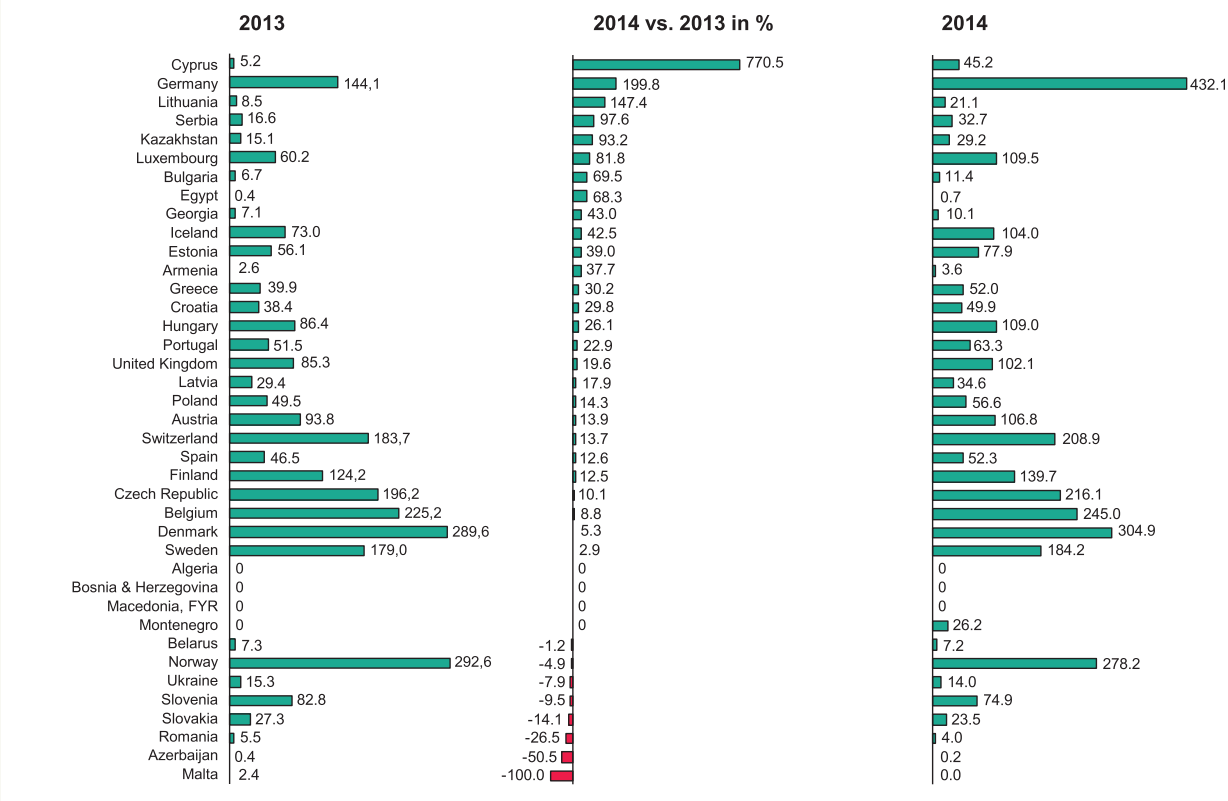

Figure 70 Change in the number of AF ablations per million inhabitants from 2013 to 2014.

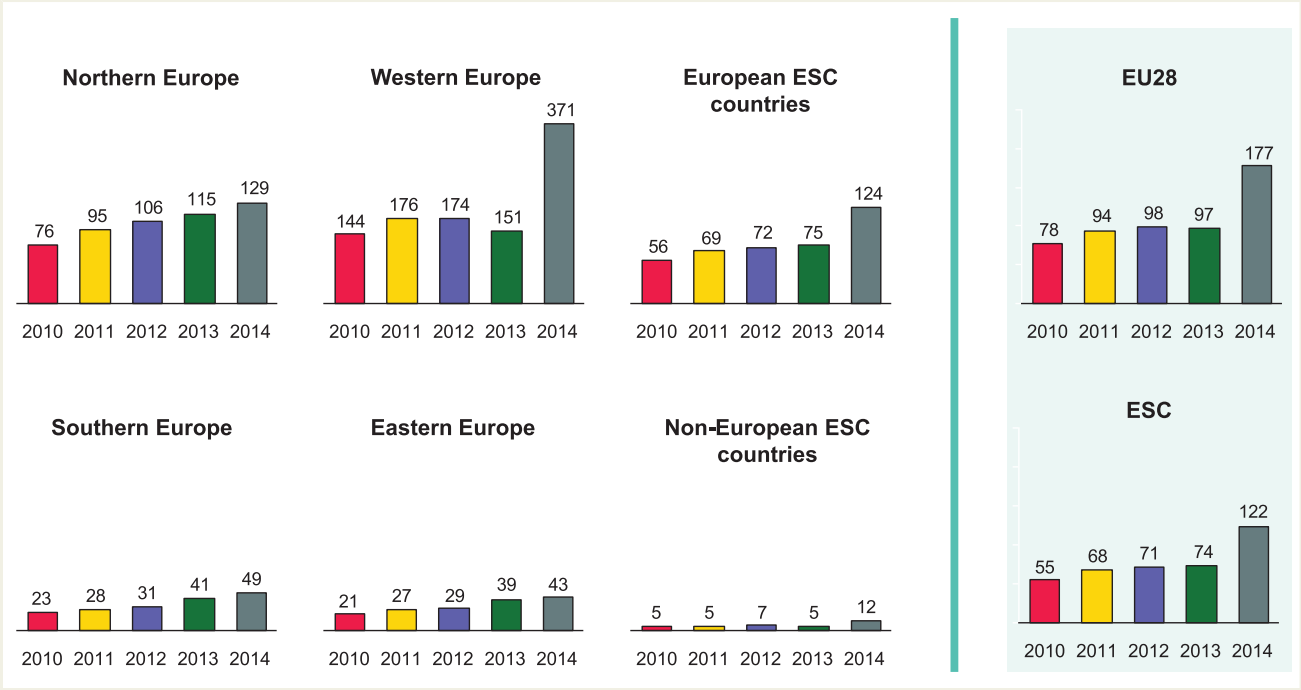

Figure 71 Atrial fibrillation ablations per million inhabitants 2010–14 in the five geographical regions of the ESC and comparison to the total ESC area and the 28 member countries of the European Union (EU28).

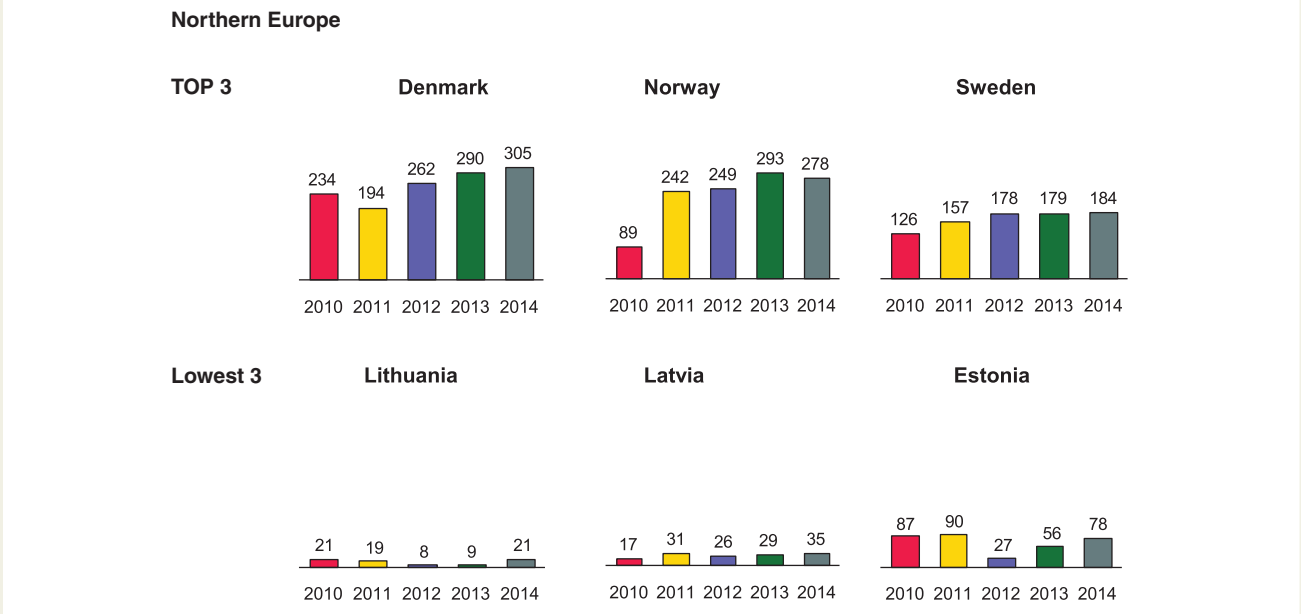

Figure 72 Atrial fibrillation ablations per million inhabitants 2010–14 in Northern Europe.

on these procedures, which are new and relatively rare in many centres. With regard to the analysis and interpretation of summary data, it was a major drawback that Italy, one of the most populated countries in ESC area, did not submit any data on catheter ablations. In addition, there were large variations in the methodology of national data collection. About 50% of the data came from national registries (20 countries) and half were based on surveys and other estimates conducted by the national working groups. This is relevant since the

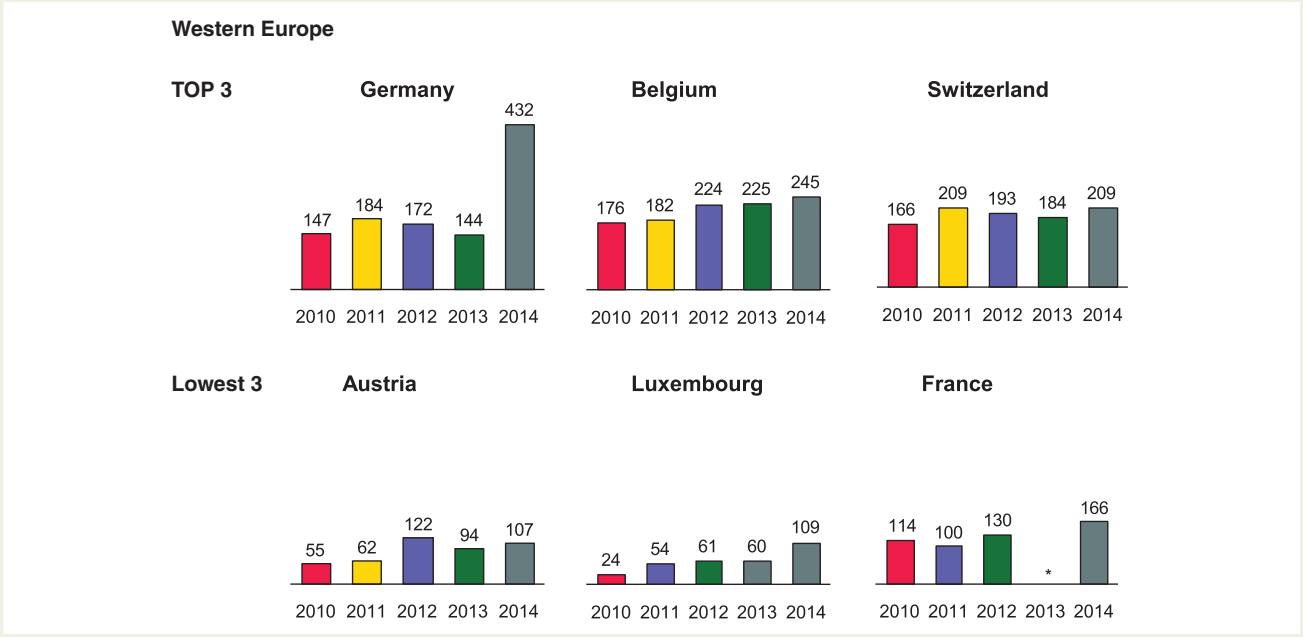

Figure 73 Atrial fibrillation ablations per million inhabitants 2010–14 in Western Europe. *No data available.

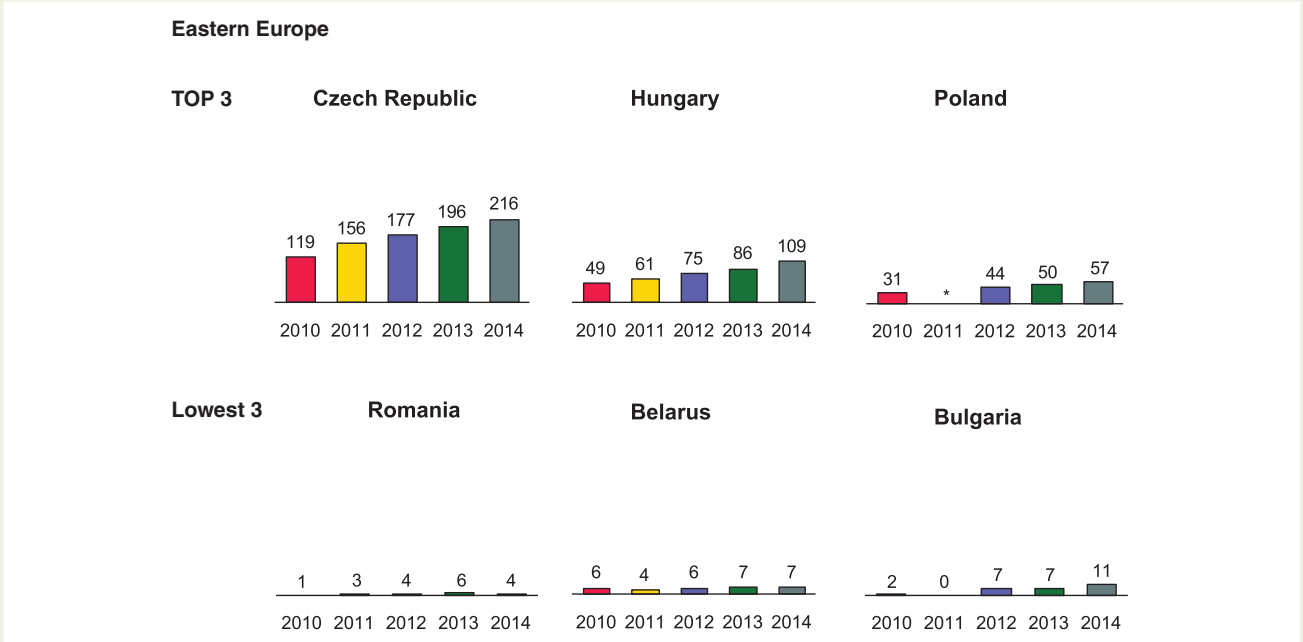

Figure 74 Atrial fibrillation ablations per million inhabitants 2010–14 in Eastern Europe. *No data available.

coverage of the registries in some of the ESC countries is relatively poor and many procedures are not included in the registry data. In contrast, surveys and other estimates conducted by the National Working Groups may overestimate the procedure numbers. For example, this year, the catheter ablation numbers for Germany were markedly higher than in the past. Whether this reflects a real increase or is related to changes in data collection methods is not known.

The ability to see its own numbers in an international context provides each country reliable means to demonstrate shortfalls in resource allocation, reimbursement, and training requirements to the national or local authorities. Therefore, for the second year

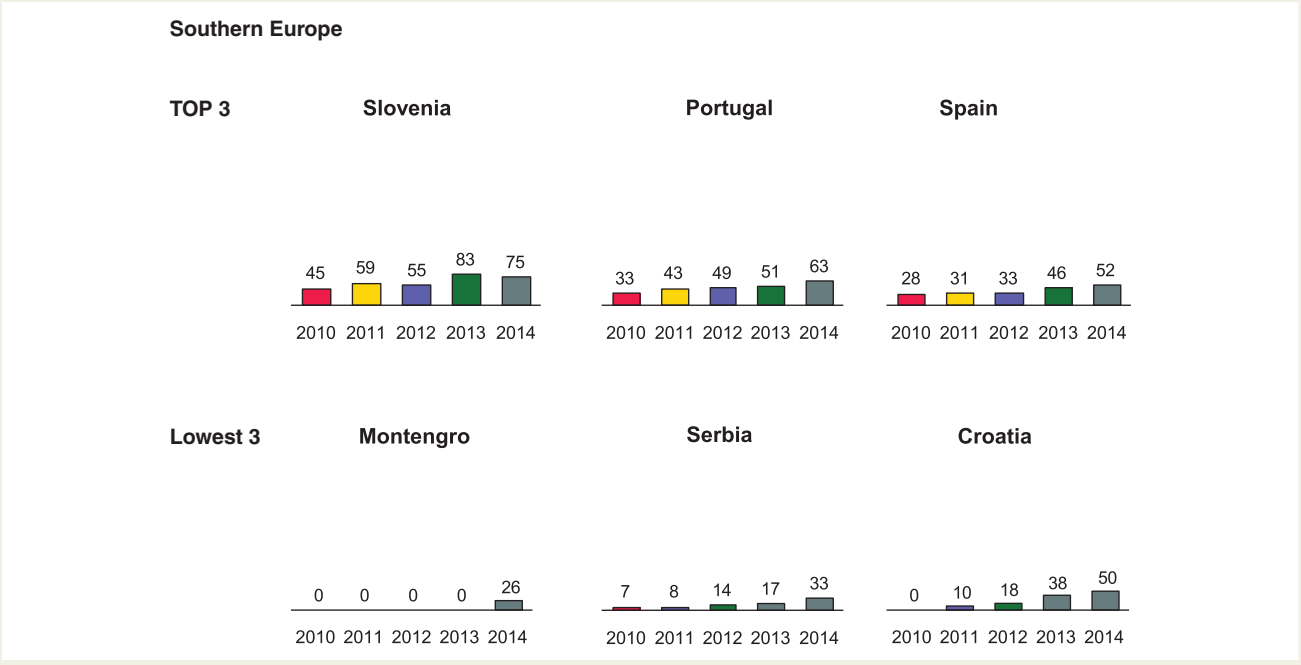

Figure 75 Atrial fibrillation ablations per million inhabitants 2010–14 in Southern Europe.

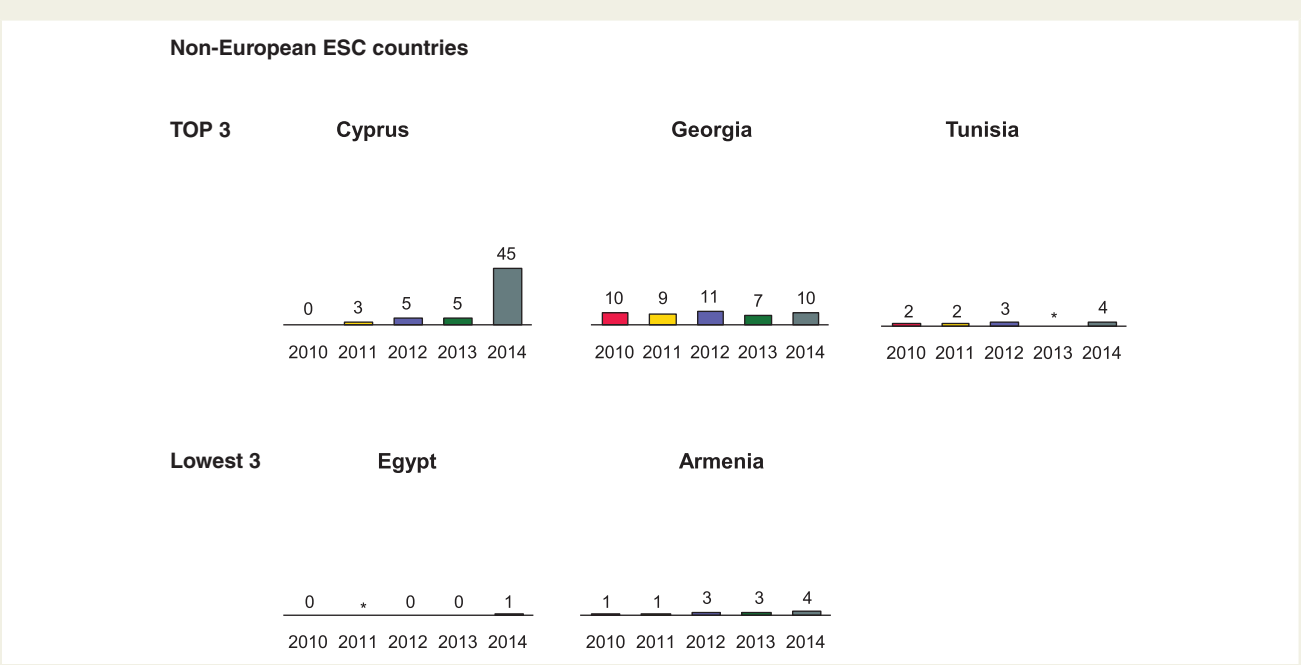

Figure 76 Atrial fibrillation ablations per million inhabitants 2010–14 in the non-European ESC countries. *No data available.

running, the data were presented separately for the five geographical regions within the ESC area. In order to avoid any economic, political, or historical bias, the European regions were composed according to the United Nations (UN) Statistics Division and all other ESC countries were included in the non-European ESC region. This classification is not free of limitations. Nevertheless, we feel that as a well-defined and widely accepted geographical classification, the UN grouping provides a neutral platform for regional comparisons within the ESC area.

Future directions of the European Heart Rhythm Association White Book project

Next year, we will be celebrating the 10-year anniversary of the EHRA White Book. For the anniversary edition, we have a specific

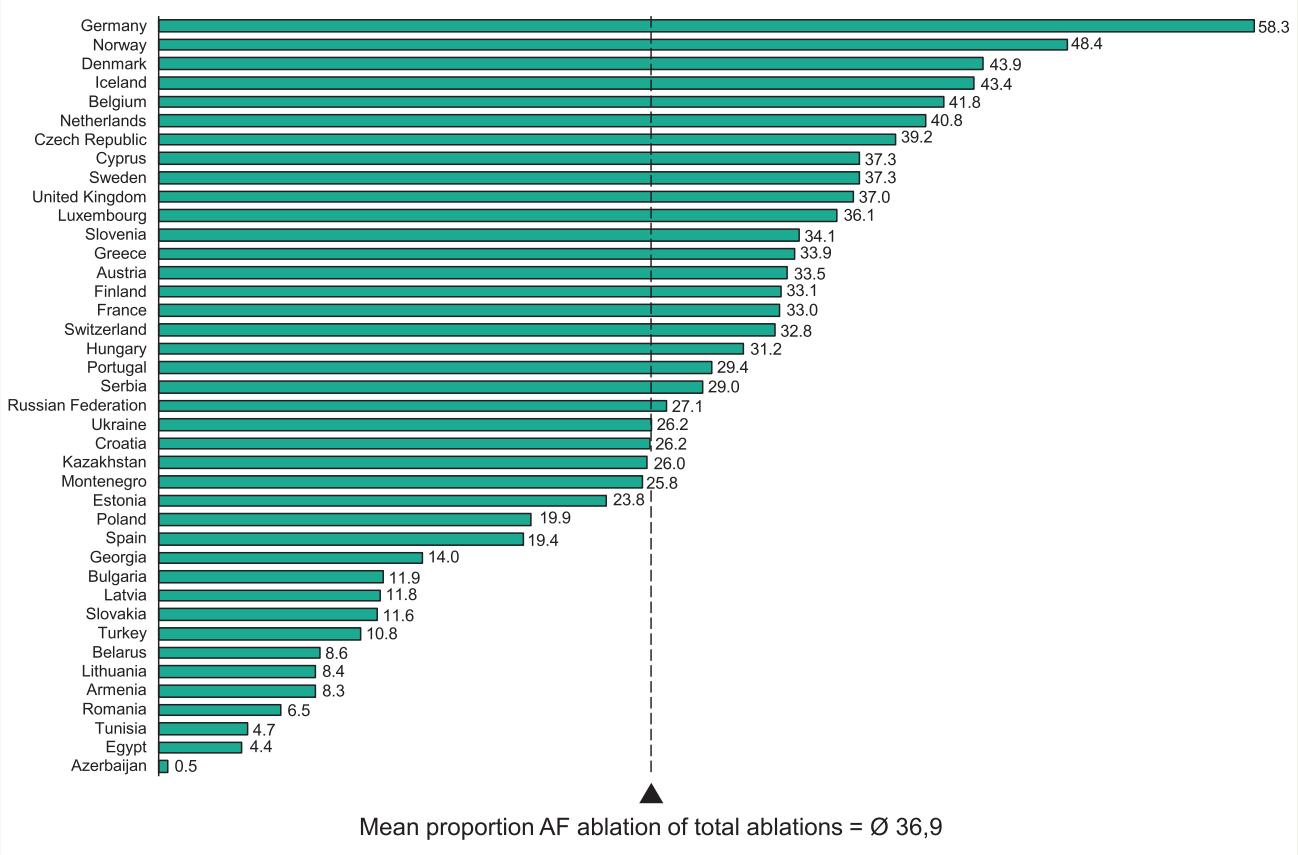

Figure 77 Proportion of AF ablations of total ablations in 2014.

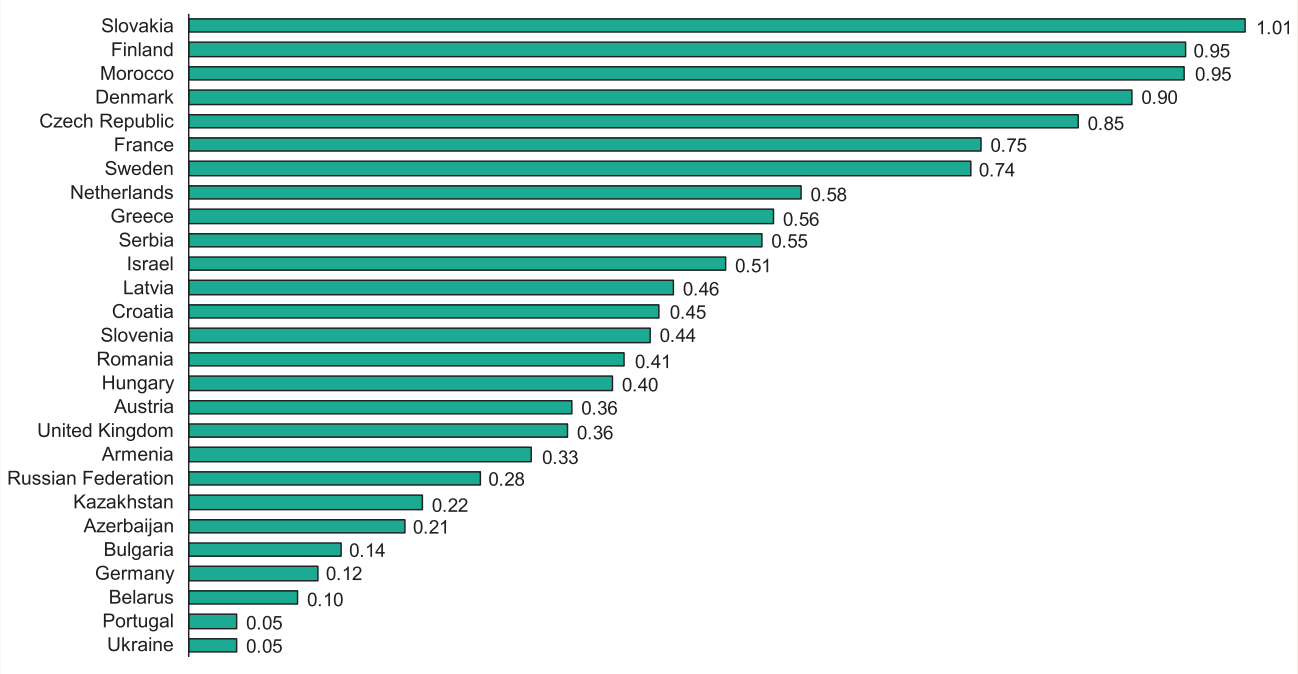

Figure 78 Number of centres which performed more than 10 VT or VF ablations per million inhabitants in patients with structural heart disease in 2014.

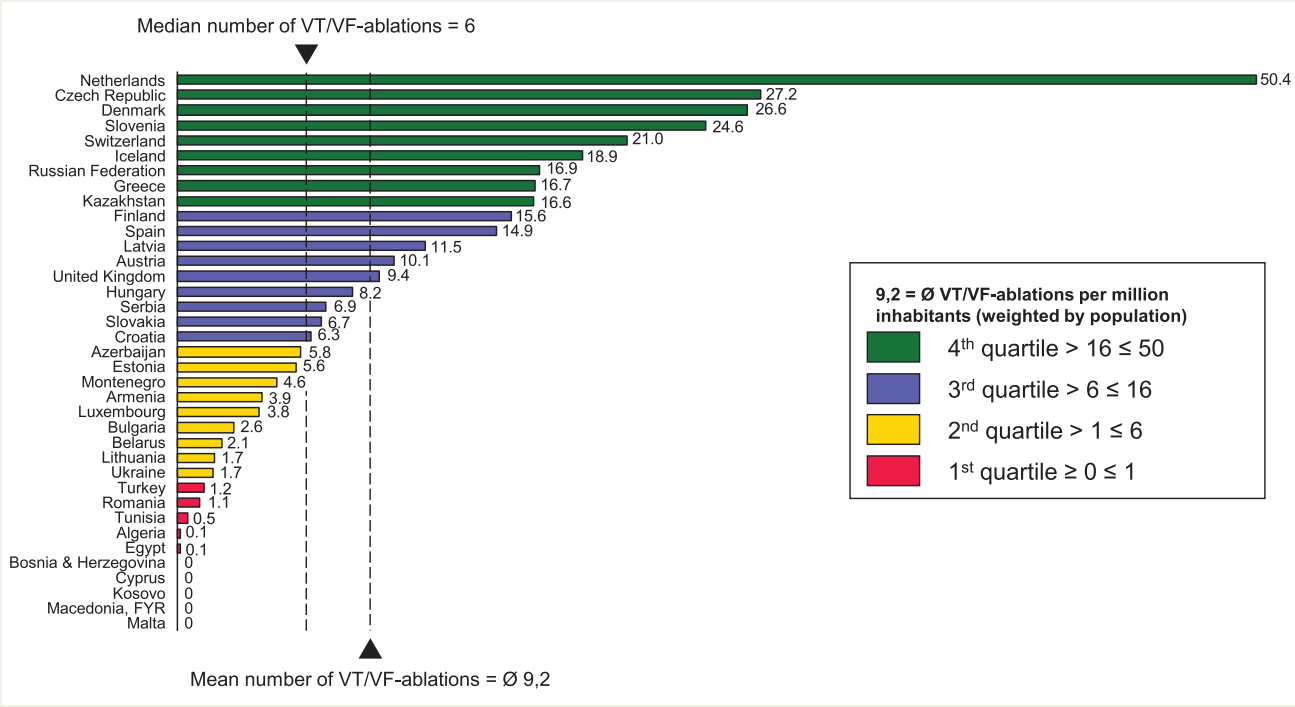

Figure 79 Ablations for VT or VF per million inhabitants in patients with structural heart disease in 2014. The mean number of VT/VF ablations is weighted by population.

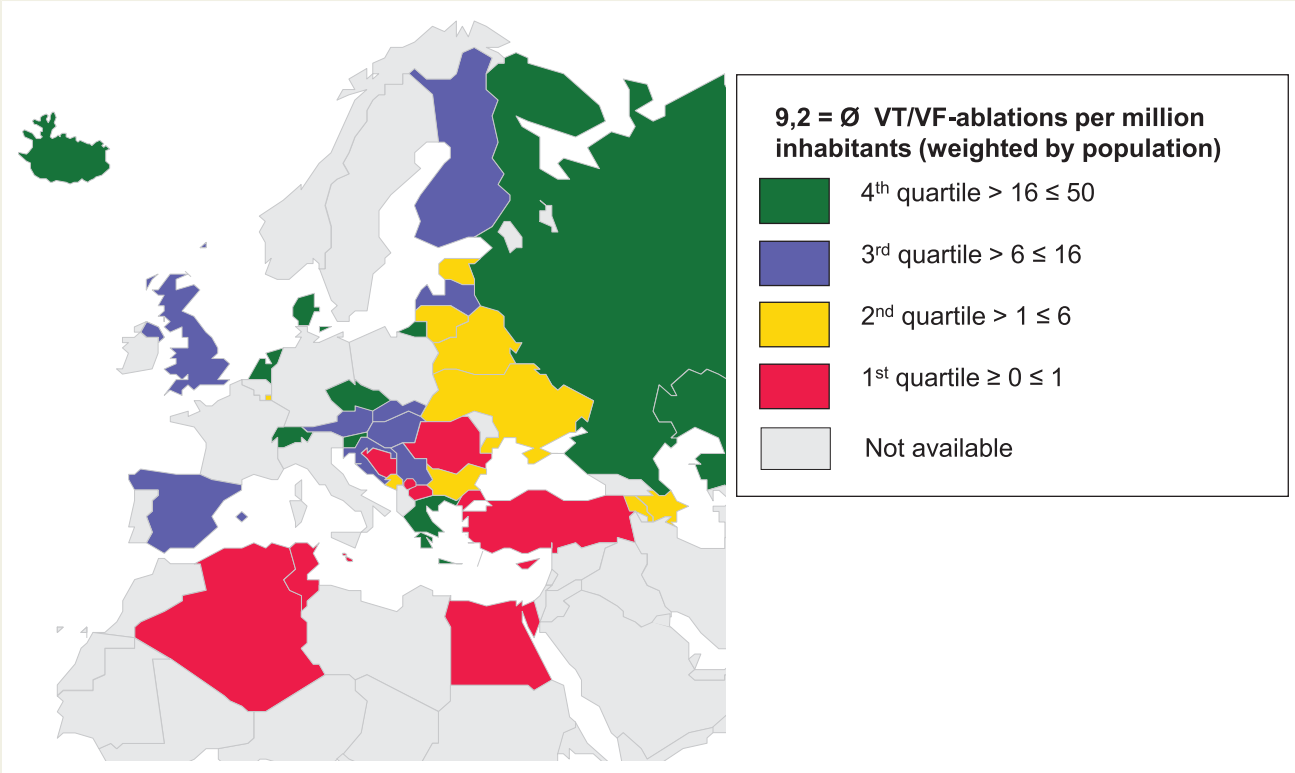

Figure 80 Ablations for VT or VF per million inhabitants in patients with structural heart disease in 2014.

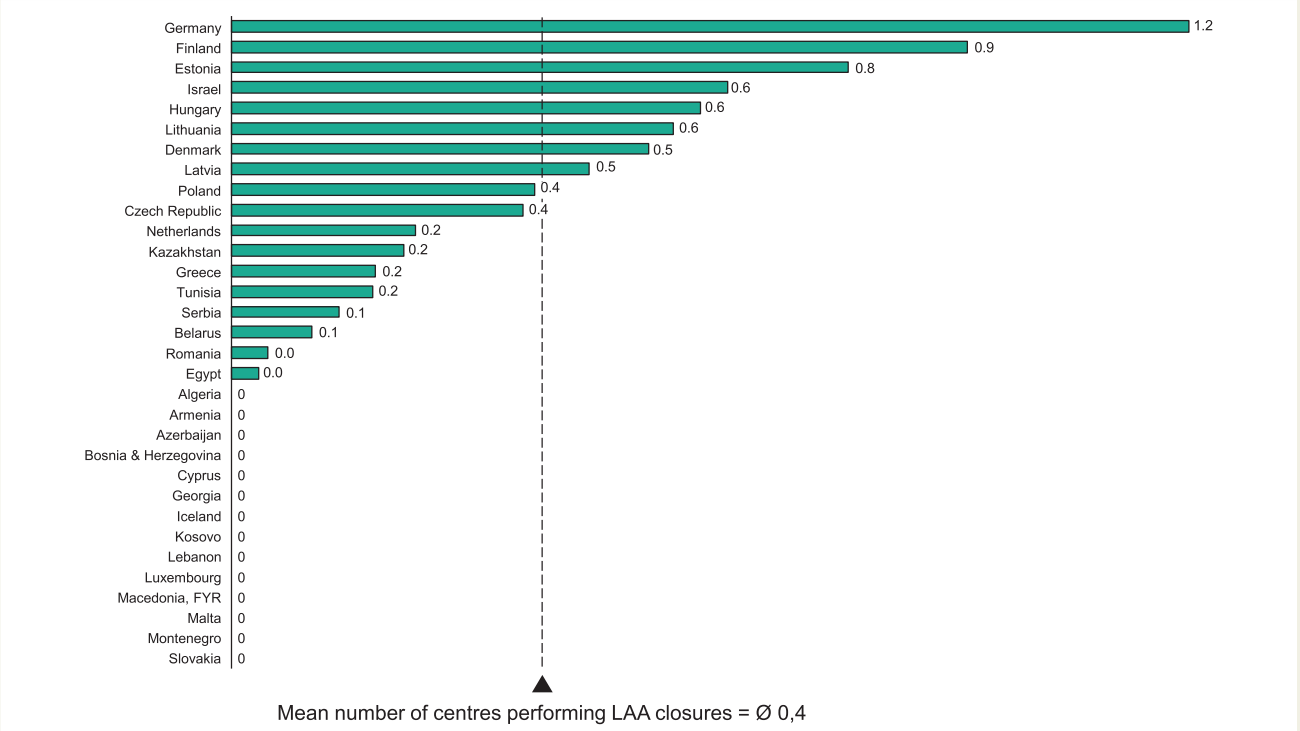

Figure 81 Number of centres performing percutaneous LAA closures per million inhabitants in 2014.

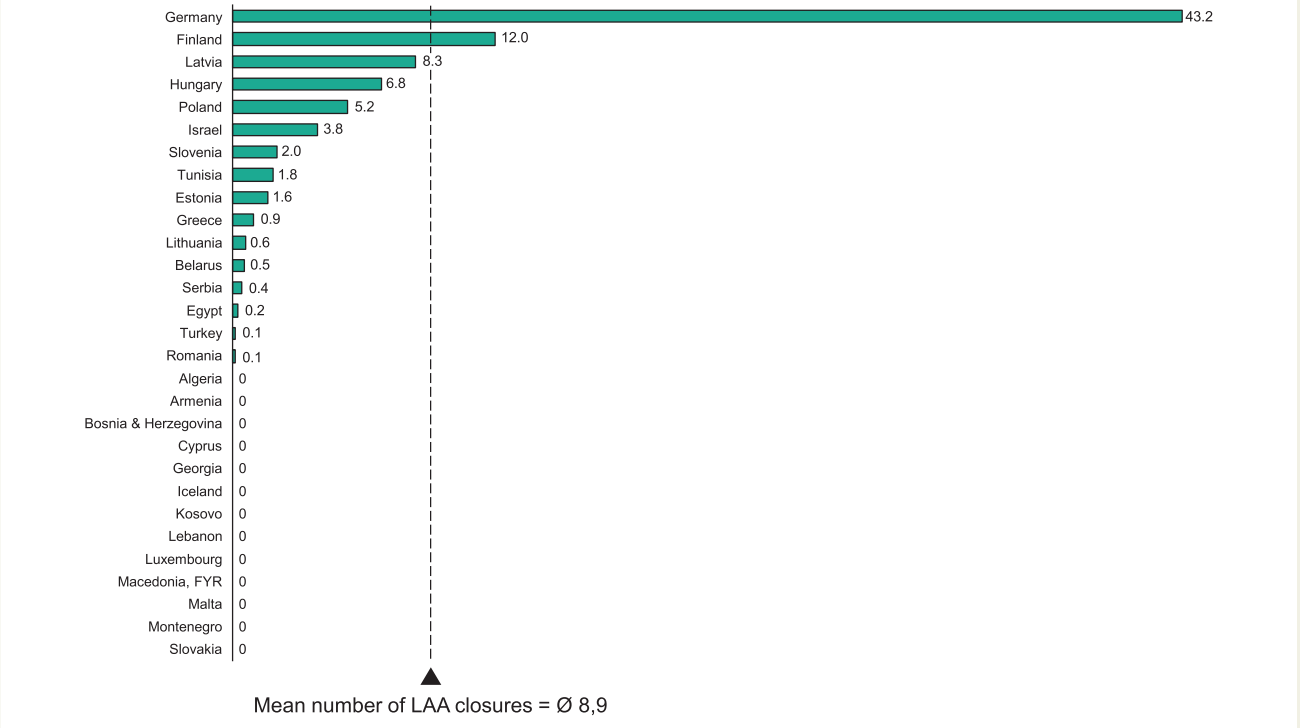

Figure 82 Percutaneous LAA closures per million inhabitants in 2014.

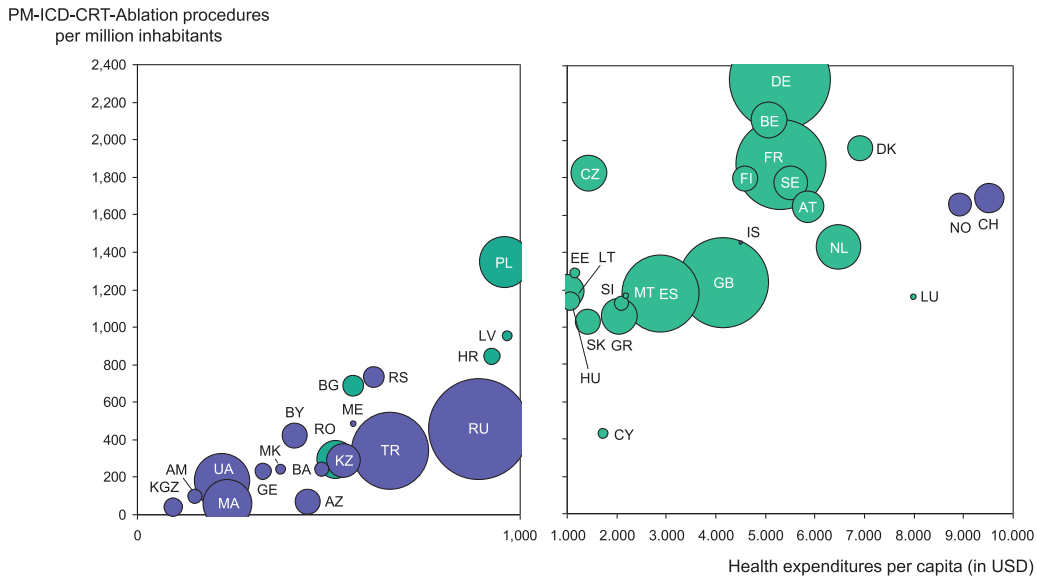

Figure 83 Healthcare spending per capita and interventional EP procedures (sum of PM–ICD–CRT–ablation procedures per million inhabitants). The ISO codes of the countries are explained in *Table 1*.

goal to increase country participation, to improve the reliability of the data and to ensure the quality of the collected data. In this regard, we rely on the endeavour of the national cardiac societies and working groups. We encourage adoption and continuous development of national registries and hope that their coverage will expand in the future. A long-term goal is to develop an electronic database, which would allow free comparisons between and within the ESC countries. Such a database would provide a unique platform for future online multicentre registry-based clinical trials in arrhythmia therapy.[25] The ESC plans to publish an Atlas on Cardiology in the near future. The Atlas will provide information on a wide range of cardiology procedures in Europe, but it will not substitute the White Book data collection.

Conclusions

During the last 9 years, the White Book has developed into a substantial asset not only for the cardiac EP community but also for healthcare administrators and politicians in the ESC area. The availability of quality information is essential to those facing the challenge of balancing healthcare budgets and allocating limited resources. The statistics presented herein show that, despite significant improvements in many areas of arrhythmia care, there is still considerable heterogeneity in the availability of invasive arrhythmia therapies across the ESC area. Reducing this gap continues to be one of the main objectives of EHRA.

Acknowledgements

The EHRA White Book 2015 and this analysis were possible thanks to the continuing efforts of several key contributors including chairmen and co-chairs of National Cardiac Societies and Arrhythmia Working Groups of the 56 ESC countries, and Yasmine Carrasset and other members of the EHRA staff at the Heart House. We are grateful for their invaluable contribution and hope that even more countries will be reporting data for the White Book next year. In addition, we want to thank the project sponsor, BIOTRONIK SE & Co. KG, and in particular to Robert Wuestenberg and Anja Thuemen for their dedication and passion in the conduction of the project. Finally, Prof. Panos Vardas and Prof. Christian Wolpert deserve special mention as the 'fathers' of the White Book project.

Conflict of interest: none declared.

References

1. Arribas F, Auricchio A, Boriani B, Camm J, Merino JL, Merkely B *et al.* The EHRA White Book. Statistics on the use of cardiac electronic devices and electrophysiological procedures in 54 ESC countries: 2012 report from the European Heart Rhythm Association (EHRA). *Europace* 2012;**14**(Suppl 3):1–55.
2. Arribas F, Auricchio A, Boriani G, Brugada J, Deharo JC, Hindriks G *et al.* Statistics on the use of cardiac electronic devices and electrophysiological procedures in 55 ESC countries: 2013 report from the European Heart Rhythm Association (EHRA). *Europace* 2014;Suppl 1:i1–78.
3. Raatikainen MJ, Arnar DO, Zeppenfeld K, Merino JL, Levya F, Hindriks G *et al.* Statistics on the use of cardiac electronic devices and electrophysiological procedures in the European Society of Cardiology countries: 2014 report from the European Heart Rhythm Association. *Europace* 2015;Suppl 1:i1–75.
4. World Health Statistics 2015. World Health Organisation. http://www.who.int/gho/publications/world health_statistics/2014/en/.
5. Health Accounts. World Health Organization. http://www.who.int/gho/publications/world_health_statistics/en/.
6. Kuck KH, Hindricks G, Padeletti L, Raatikainen P, Arnar D. EHRA White Book, 2015. http://www.escardio.org/communities/EHRA/publications/Documents/ehra-white-book-2015.pdf.
7. Deharo JC, Bongiorni MG, Rozkovec A, Bracke F, Defaye P, Fernandez-Lozano I *et al.* Pathways for training and accreditation for transvenous lead extraction: a European Heart Rhythm Association position paper. *Europace* 2012;**14**:124–34.
8. Van Erven L, Morgan JM, Scientific Initiatives Committee (SIC). Attitude towards redundant leads and the practice of lead extractions: a European survey. *Europace* 2010;**12**:275–6.
9. Bongiorni MG, Blomström-Lundqvist C, Kennergren C, Dagres N, Pison L, Svendsen JH *et al.* Current practice in transvenous lead extraction: a European Heart Rhythm Association EP Network Survey. *Europace* 2012;**14**:783–864.

10. Holmes DR Jr, Doshi SK, Kar S, Price MJ, Sanchez JM, Sievert H *et al.* Left atrial appendage closure as an alternative to warfarin for stroke prevention in atrial fibrillation: a patient-level meta-analysis. *J Am Coll Cardiol* 2015;**65**:2614–23.
11. Meir B, Blaauw Y, Khattab AA, Lewalter T, Sievert H, Tondo C *et al.* EHRA/EAPCI expert consensus statement on catheter-based left atrial appendage occlusion. http://europace.oxfordjournals.org/content/early/2014/09/08/europace.euu174.full.
12. Merkely B, Kautzner J, Milasinovic G, Hatala R, Taborsky M, Lubinski A *et al.* EHRA Summit 2010. Summary statement: EHRA summit 2010 with the participation of Central-Eastern European countries: 'ICD for Life' Initiative--fighting against sudden cardiac death in emerging economies. *Europace* 2011;**13**:1209–10.
13. Wolpert C, Lubinski A, Bissinger A, Merkely B, Priori S, Brugada J. Barriers to implementation of evidence-based electrical therapies and the need for outcome research: role of European registries. *Europace* 2011;**13** Suppl 2:ii18–20.
14. Karanikolos M, Mladovsky P, Cylus J, Thomson S, Basu S, Stuckler D *et al.* Financial crisis, austerity, and health in Europe. *Lancet* 2013;**381**:1323–31.
15. Boriani G, Maniadakis N, Auricchio A, Vardas P. Health economics and outcomes research: a new challenge and field of action for the European Heart Rhythm Association. *Europace* 2010;**12**:601–3.
16. Vardas P, Boriani G. Health economics and the European Heart Rhythm Association. *Europace* 2011;**13** Suppl 2:ii1–2.
17. Boriani G, Maniadakis N, Auricchio A, Muller-Riemenschneider F, Fattore G *et al.* Health technology assessment in interventional electrophysiology and device therapy: a position paper of the European Heart Rhythm Association. *Eur Heart J* 2013;**34** Suppl 2:1869–74.
18. Zipes DP, Camm AJ, Borggrefe M, Buxton AE, Chaitman B, Fromer M *et al.* ACC/AHA/ESC 2006 guidelines for management of patients with ventricular arrhythmias and the prevention of sudden cardiac death. A report of the American College of Cardiology/American Heart Association Task Force and the European Society of Cardiology Committee for Practice Guidelines. *Europace* 2006;**8**:746–837.
19. Pedersen CT, Kay GN, Kalman J, Borggreffe M, Della-Bella P, Dickfield T *et al.* EHRA/HRS/APHRS expert consensus on ventricular arrhythmias. *Europace* 2014;**16**:1257–83.
20. John RM, Tedrow UB, Koplan BA, Albert CM, Epstein LM, Sweeney MO *et al.* Ventricular arrhythmias and sudden cardiac death. *Lancet* 2012;**380**:1520–9.
21. Braunschweig F, Boriani G, Bauer A, Hatala R, Herrmann-Lingen C, Kautzner J *et al.* Management of patients receiving implantable cardiac defibrillator shocks: recommendations for acute and long-term patient management. *Europace* 2010;**12**:1673–90.
22. Kuck KH, Schaumann A, Eckardt L, Willems R, Delacretaz E, Pitschner HF *et al.* Catheter ablation of stable ventricular tachycardia before defibrillator implantation in patients with coronary heartdisease (VTACH): a multicentre randomised controlled trial. *Lancet* 2010;**375**:31–40.
23. Reddy VY, Reynolds MR, Neuzil P, Richardson AW, Taborsky M, Jonqnaranqsin K *et al.* Prophylactic catheter ablation for the prevention of defibrillator therapy. *N Engl J Med* 2007;**357**:2657–65.
24. Wissner E, Stevenson WG, Kuck KH. Catheter ablation of ventricular tachycardia in ischaemic and non-ischaemic cardiomyopathy: where are we today? A clinical review. *Eur Heart J* 2012;**33**:1440–50.
25. Lauer MS, D'Agostino RB. The randomized registry trial – the next disruptive technology in clinical research. *N Engl J Med* 2013;**369**:157–81.