

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

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Aims

There has been large variations in the use of invasive electrophysiological therapies in the member countries of the European Society of Cardiology (ESC). The aim of this analysis was to provide comprehensive information on cardiac implantable electronic device (CIED) and catheter ablation therapy trends in the ESC countries over the last five years.

Methods

The European Heart Rhythm Association (EHRA) has collected data on CIED and catheter ablation therapy since 2008. Last year 49 of the 56 ESC member countries provided data for the EHRA White Book. This analysis is based on the current and previous editions of the EHRA White Book. Data on procedure rates together with information on economic aspects, local reimbursement systems and training activities are presented for each ESC country and the five geographical ESC regions.

Results

In 2013, the electrophysiological procedure rates per million population were highest in Western Europe followed by the Southern and Northern European countries. The CIED implantation and catheter ablation rate was lowest in the Eastern European and in the non-European ESC countries, respectively. However, in some Eastern European countries with relative low gross domestic product procedure rates exceeded those of some wealthier Western countries, suggesting that economic resources are not the only driver for utilization of arrhythmia therapies.

Conclusion

These statistics indicate that despite significant improvements, there still is considerable heterogeneity in the availability of arrhythmia therapies across the ESC area. Hopefully, these data will help identify areas for improvement and guide future activities in cardiac arrhythmia management.

Keywords

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

Introduction

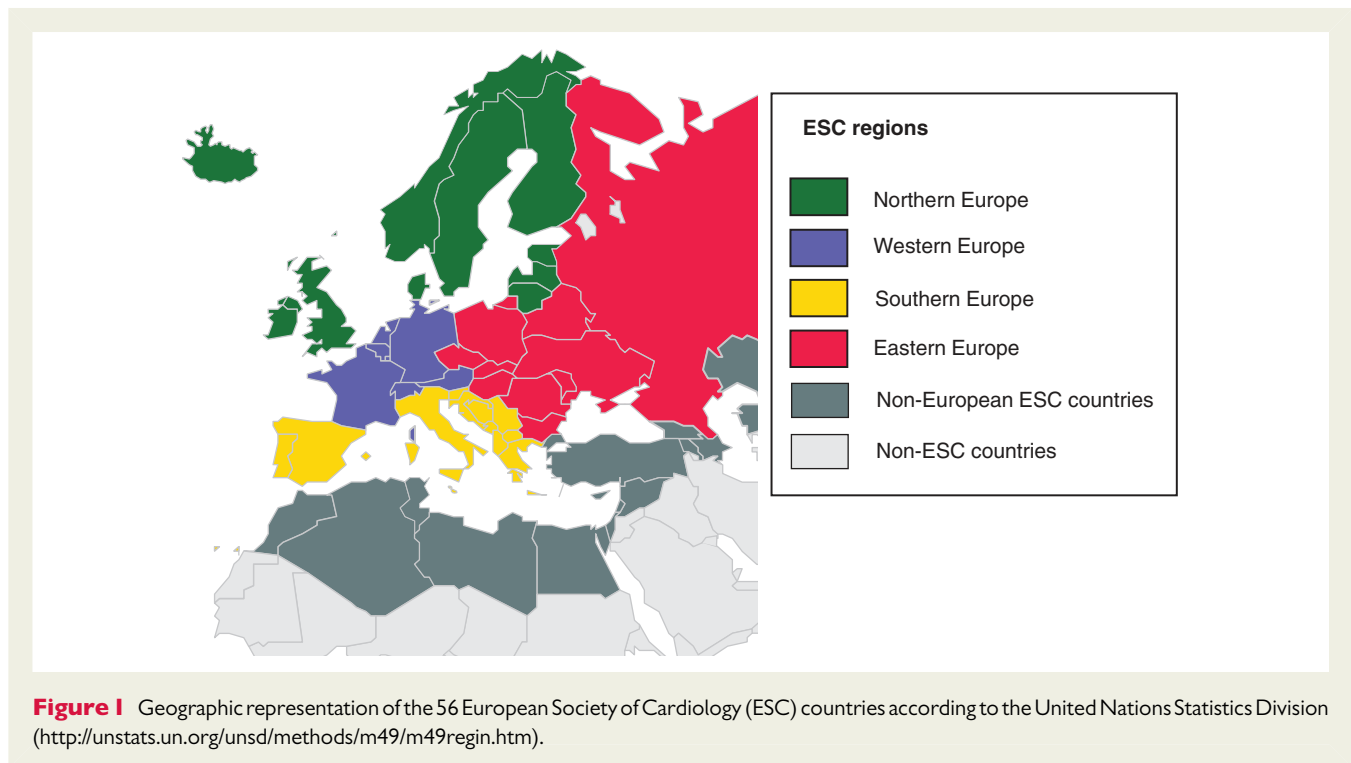
This is the third year that the EHRA White Book data on the status of cardiac implantable electronic device (CIED) therapy and catheter ablation are published as a full EP Europace supplement. As in past editions, the objective is to provide comprehensive information on the

trends in the use of invasive treatment for cardiac rhythm disorders in the member countries of the European Society of Cardiology (ESC).

In addition to statistics on the various invasive electrophysiological procedures, we have provided information on the social, financial, and economic aspects in the constituent ESC countries. We hope that, together with information on local reimbursement systems, these

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data will contribute to the understanding of the economic aspects of electrophysiological procedures in countries affiliated to the European Heart Rhythm Association (EHRA). We also report on electrophysiology (EP) training requirements and new training initiatives.

The methodology of the EHRA White Book data collection and analysis has been described elsewhere.¹ In order to facilitate comparisons among various ESC countries, we presented regional data for the last five years separately for the Eastern, Northern, Southern, and Western Europe, and for the non-European ESC countries. The European regions were composed according to the United Nations (UN) Statistics Division (<http://unstats.un.org/unsd/methods/m49/m49regin.htm>) without taking into account any economic, political, or historical aspects (Figure 1). Distribution of population within these regions over the last five years is shown in Table 1.

Our analysis revealed considerable differences in the pacemaker (PM), implantable cardioverter defibrillator (ICD), and cardiac resynchronization therapy (CRT) device implantation rates between the ESC member countries. As in previous years, the mean CIED implantation rates per million population were higher in the Western Europe than in the other regions. The mean numbers were lowest in the Eastern Europe and in the non-European ESC countries. However, in some Eastern European countries, implantation rates for PM and ICDs per million inhabitants exceeded those of some Western European countries, suggesting that gross domestic product (GDP) is not the only driver for utilization of device therapies.

During the last decade, the use of catheter ablation in the ESC area has increased substantially mainly due to the development of invasive therapies for atrial fibrillation. It was interesting to note that in many Eastern European countries where access to ablation therapy until 5–10 years ago was extremely limited due to financial and training restrictions, the numbers of catheter ablation were still growing rapidly. In contrast, the number of catheter ablations per million population remained stable or even decreased slightly in the

Northern and Western Europe. In most non-European ESC countries, the number of catheter ablations was markedly lower than in the other ESC regions. Whether this is due to economic restrictions or to more precise patient selection is unknown. Ablation therapies may be more susceptible to financial restrictions, training, and education resources than device therapies, which are frequently used for immediate and often life-saving indications.

European Heart Rhythm Association Certification and Training Fellowship Programs have been very successful and have provided a platform for EHRA's goal to promote unified standards for the training of cardiac rhythm management specialists and to assure high-quality in arrhythmia care all over the ESC area. Last year 260 physicians and 69 allied professionals participated in the EHRA Certification Examination. European Heart Rhythm Association fellowship grants have allowed many young physicians from emerging economies to be trained in high volume centres outside of their home country.

The White Book has played a key role in the ICD for life programme² and many other strategic initiatives and awareness activities of the EHRA. Over the years, several improvements have been made, but the current data indicate that there is still room for further development. We hope that these statistics will guide future activities in the field of cardiac arrhythmia management and promote EHRA's mission, namely "to improve the quality of life of the European population by reducing the impact of cardiac arrhythmias and reduce sudden cardiac death".

Societal, financial, and economic aspects

General information

In this section, an overview of the demographic and financial profile of the 56 ESC countries is provided. Population and vital statistics and GDP in the 56 ESC countries are presented in Tables 1 and 2. It is

Table I Populations in the five geographical European Society of Cardiology regions in 2009–2013

	ISO code	Population				
		2009	2010	2011	2012	2013
Northern Europe						
Denmark	DK	5 519 441	5 550 000	5 529 888	5 543 453	5 556 452
Estonia	EE	1 340 271	1 341 000	1 282 963	1 274 709	1 266 375
Finland	FI	5 338 871	5 365 000	5 259 250	5 262 930	5 266 114
Iceland	IS	319 246	320 000	311 058	313 183	315 281
Ireland	IE	4 459 305	4 470 000	4 670 976	4 722 028	4 775 982
Latvia	LV	2 254 834	2 252 000	2 204 708	2 191 580	2 178 443
Lithuania	LT	3 339 455	3 324 000	3 535 547	3 525 761	3 515 858
Norway	NO	4 828 726	4 883 000	4 691 849	5 000 000	5 085 582
Sweden	SE	9 298 515	9 380 000	9 088 728	9 103 788	9 647 386
United Kingdom	GB	61 791 956	62 036 000	62 698 362	63 047 162	63 395 574
Total		98 490 619	98 921 000	99 273 329	99 984 594	101 003 047
Western Europe						
Austria	AT	8 363 040	8 394 000	8 217 280	8 219 743	8 221 646
Belgium	BE	10 646 804	10 712 000	10 431 477	11 082 744	10 444 268
France	FR	62 342 668	62 787 000	65 102 719	65 630 692	65 951 611
Germany	DE	81 874 768	82 302 000	81 471 834	81 305 856	81 147 265
Luxembourg	LU	486 181	507 000	503 302	509 074	514 862
Netherlands	NL	16 445 593	16 613 000	16 653 734	16 730 632	16 805 037
Switzerland	CH	7 567 659	7 664 000	7 639 961	7 925 517	7 996 026
Total		187 726 713	188 979 000	190 020 307	191 404 258	191 080 715
Eastern Europe						
Belarus	BY	9 665 120	9 595 000	9 577 552	9 643 566	9 625 888
Bulgaria	BG	7 585 131	7 494 000	7 093 635	7 037 935	6 981 642
Czech Republic	CZ	10 491 492	10 493 000	10 190 213	10 177 300	10 609 762
Hungary	HU	10 022 650	9 984 000	9 976 062	9 958 453	9 939 470
Moldova	MD	3 770 698	3 731 799	3 694 121	3 656 843	3 619 925
Poland	PL	38 153 388	38 277 000	38 441 588	38 415 284	38 383 809
Romania	RO	21 469 960	21 431 298	21 904 551	21 848 504	21 790 479
Russian Federation	RU	141 909 248	142 958 000	138 739 892	142 517 670	142 500 482
Slovakia	SK	5 418 374	5 462 000	5 477 038	5 483 088	5 488 339
Ukraine	UA	45 872 976	45 448 000	45 134 707	45 416 589	44 573 205
Total		294 359 037	294 874 097	290 229 359	294 155 232	293 513 001
Southern Europe						
Albania*	AL	3 194 417	3 204 000	2 994 667	3 002 859	3 011 405
Bosnia and Herzegovina	BA	3 838 161	3 760 000	4 622 163	3 879 296	3 875 723

Continued

Table I Continued

	ISO code	Population				
		2009	2010	2011	2012	2013
Croatia	HR	4 429 078	4 403 000	4 483 804	4 480 043	4 475 611
Greece	GR	11 282 751	11 359 000	10 760 136	10 767 827	10 772 967
Italy	IT	60 192 696	60 551 000	61 016 804	61 261 254	61 482 297
Kosovo*	XK	1 804 838	1 815 048	1 825 632	1 836 529	1 847 708
FYR Macedonia	MK	2 042 485	2 061 000	2 077 328	2 082 370	2 087 171
Malta	MT	413 290	417 000	408 333	409 836	411 277
Montenegro	ME	631 536	631 000	661 807	657 394	653 474
Portugal	PT	10 632 482	10 676 000	10 760 305	10 781 459	10 799 270
San Marino	SM	28 976	32 000	31 817	32 140	32 448
Serbia	RS	7 320 807	7 291 436	7 310 555	7 276 604	7 243 007
Slovenia	SI	2 042 335	2 030 000	2 000 092	1 996 617	1 992 690
Spain	ES	45 929 476	46 077 000	46 754 784	47 042 984	47 370 542
Total		153 783 328	154 307 484	155 708 227	155 507 212	156 055 590
Non-European ESC countries						
Algeria	DZ	35 268 128	35 949 869	34 994 937	37 367 226	38 087 812
Armenia	AM	3 243 729	3 092 000	2 967 975	2 970 495	3 064 267
Azerbaijan	AZ	9 206 777	9 301 673	9 397 279	9 493 600	9 590 159
Cyprus	CY	803 147	1 104 000	1 120 489	1 138 071	1 155 403
Egypt	EG	78 866 635	80 471 869	82 079 636	83 688 164	85 294 388
Georgia	GE	4 410 900	4 352 000	4 585 874	4 570 934	4 942 157
Israel	IL	7 485 600	7 418 000	7 473 052	7 590 758	7 707 042
Kazakhstan	KZ	16 863 280	17 084 817	17 304 513	17 522 010	17 736 896
Kyrgyzstan*	KGZ	5 358 180	5 410 468	5 450 776	5 496 737	5 548 042
Lebanon	LB	4 099 315	4 125 247	4 143 101	4 140 289	4 131 583
Libya*	LY	6 002 252	6 110 364	6 597 960	5 613 380	6 002 347
Morocco	MA	31 285 174	31 627 428	31 968 361	32 309 239	32 649 130
Syria*	SY	21 762 978	22 198 110	22 517 750	22 530 746	22 457 336
Tunisia*	TN	10 420 551	10 525 041	10 629 186	10 732 900	10 835 873
Turkey*	TR	72 561 312	72 752 000	78 785 548	79 749 461	80 694 485
Total		307 637 958	311 522 886	320 016 437	324 914 010	329 896 920
Total ESC countries	56	1 041 997 655	1 048 604 467	1 055 247 659	1 065 965 306	1 071 549 273

Table 2 Population and vital statistics and and gross domestic product in the 56 ESC countries. *These seven countries did not submit data for the EHRA White Book 2014.

Country	Population	Population growth rate (%)	Life expectancy at birth (years)	Death rate (%) per 1000 population	GDP (x 1000 billion USD)	GDP per capita (USD)	Total health expenditure as % of GDP
Albania*	3 011 405	0.28	77.80	5.68	13.16	4039	6.32
Algeria	38 087 812	1.91	76.20	N/A	215.72	5668	N/A
Armenia	3 064 267	-0.09	74.00	8.56	10.44	3176	4.34
Austria	8 221 646	0.02	80.00	9.08	417.90	49 256	10.64
Azerbaijan	9 590 159	1.01	71.60	5.88	76.01	8165	5.24
Belarus	9 625 888	-0.18	71.80	13.97	69.24	7414	5.32
Belgium	10 444 268	0.06	79.80	9.62	507.42	45 537	10.60
Bosnia & Herzegovina	3 875 723	-0.09	76.10	9.12	18.87	4866	10.22
Bulgaria	6 981 642	-0.80	74.10	14.73	53.70	7411	7.28
Croatia	4 475 611	-0.10	76.20	11.59	58.60	13 312	7.82
Cyprus	1 155 403	1.51	78.20	6.27	21.78	24 706	7.42
Czech Republic	10 609 762	0.17	78.10	10.18	198.63	18 848	7.38
Denmark	5 556 452	0.23	78.90	9.37	324.29	57 999	11.16
Egypt	85 294 388	1.90	73.20	N/A	262.03	3114	N/A
Estonia	1 266 375	-0.66	73.80	11.35	24.28	18 127	5.96
Finland	5 266 114	0.06	79.60	9.38	259.63	47 625	8.86
France	65 951 611	0.49	81.60	8.58	2738.68	42 991	11.64
Georgia	4 942 157	-0.16	75.50	10.71	15.95	3558	9.44
Germany	81 147 265	-0.20	80.30	10.42	3593.24	43 952	11.60
Greece	10 772 967	0.05	80.20	9.83	243.33	21 617	9.04
Hungary	9 939 470	-0.19	75.20	12.92	130.56	13 172	7.76
Iceland	315 281	0.67	81.10	6.27	14.59	45 315	9.08
Ireland	4 775 982	1.14	80.40	6.08	220.89	47 882	9.38
Israel	7 707 042	1.52	81.20	5.17	272.74	34 651	7.74
Italy	61 482 297	0.36	82.00	9.67	2068.37	33 909	9.50
Kazakhstan	17 736 896	1.22	69.90	8.94	224.86	13 048	3.92
Kosovo*	1 847 708	0.61	70.80	N/A	6.99	N/A	N/A
Kyrgyzstan*	5 548 042	0.93	69.80	6.64	7.23	1282	6.50
Latvia	2 178 443	-0.60	73.20	13.43	30.38	14 924	6.18
Lebanon	4 131 583	-0.21	75.50	N/A	43.49	10 708	N/A
Libya*	6 002 347	6.70	75.80	N/A	70.92	10 864	N/A
Lithuania	3 515 858	-0.28	75.80	12.81	46.71	15 633	6.60
Luxembourg	514 862	1.13	79.90	7.18	60.54	110 573	7.70
FYR Macedonia	2 087 171	0.23	75.60	9.30	10.51	5073	6.58

Continued

Table 2 Continued

Country	Population	Population growth rate (%)	Life expectancy at birth (years)	Death rate (%) per 1000 population	GDP (x 1000 billion USD)	GDP per capita (USD)	Total health expenditure as % of GDP
Malta	411 277	0.35	80.00	7.86	9.32	22 323	8.74
Moldova	3 619 925	-1.01	69.80	11.11	7.88	2214	11.38
Montenegro	653 474	-0.60	78.10	9.29	4.52	7252	9.32
Morocco	32 649 130	1.05	76.30	N/A	104.80	3190	N/A
Netherlands	16 805 037	0.44	81.00	8.13	800.54	47 651	11.96
Norway	5 085 582	1.28	81.50	8.34	515.83	101 271	9.08
Poland	38 383 809	-0.08	76.50	9.75	513.93	13 334	6.74
Portugal	10 799 270	0.17	78.90	9.78	219.29	20 663	10.36
Romania	21 790 479	-0.27	74.50	12.12	183.79	8630	5.84
Russian Federation	142 500 482	-0.01	69.90	14.20	2117.83	14 973	6.20
San Marino	32 448	0.95	83.10	7.34	1.87	N/A	7.18
Serbia	7 243 007	-0.46	74.80	14.18	43.68	6017	10.44
Slovakia	5 488 339	0.10	76.20	9.84	96.96	17 929	8.70
Slovenia	1 992 690	-0.20	77.70	9.08	46.82	22 719	9.06
Spain	47 370 542	0.69	81.40	8.41	1355.66	29 409	9.44
Sweden	9 647 386	0.77	81.80	9.65	552.04	57 297	9.36
Switzerland	7 996 026	0.89	82.30	8.01	646.20	80 276	10.86
Syria*	22 457 336	-0.33	75.10	N/A	N/A	N/A	N/A
Tunisia*	10 835 873	0.95	75.50	N/A	48.38	4431	N/A
Turkey*	80 694 485	1.18	73.00	5.10	821.80	10 745	6.66
Ukraine	44 573 205	-0.63	68.90	14.60	175.53	3862	7.26
United Kingdom	63 395 574	0.55	80.30	9.02	2489.67	39 049	9.32

EHRA White Book 2014, <http://www.census.gov/ipc/www/idb/informationGateway.php>, <http://data.euro.who.int/hfad/>, <http://www.imf.org/external/ns/cs.aspx?id=28> (2013=IMF est.), World Health Organization National Health Account database.

*These seven countries did not submit data for the EHRA White Book 2014.

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 EP therapies		
			Public insurance	Private insurance	Private co-payment		ICD	PM	Ablation
Albania ^a									
Algeria	Yes	30	100	0	0	Yes	No	No	No
Armenia	No	65	0	70	30	N/A	Yes	Yes	Yes
Austria	Yes	1.8	85	N/A	15	Yes	No	No	No
Azerbaijan	Yes	0	70	10	20	Yes	Yes	Yes	Yes
Belarus	Yes	0	100	N/A	N/A	Yes	No	No	No
Belgium	Yes	1	N/A	N/A	N/A	Yes	No	No	No
Bosnia & Herzegovina	No	25	75	0	0	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	No	15	85	15	0	No	No	No	No
Czech Republic	Yes	0.1	99.9	0.1	N/A	Yes	No	No	No
Denmark	Yes	0	100	0	0	Yes	No	No	No
Egypt	No	35	64	1	35	Yes	Yes	Yes	Yes
Estonia	Yes	N/A	N/A	N/A	N/A	Yes	No	No	No
Finland	Yes	0	75	3	22	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	No	2	75	10	15	Yes	No	No	No
Greece	Yes	15	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	52	48	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 ^a									
Kyrgyzstan ^a									
Latvia	Yes	0	88	12	0	Yes	Yes	Yes	No
Lebanon	No	40	25	25	10	N/A	Yes	Yes	Yes
Libya ^a									
Lithuania	Yes	0	98	2	0	Yes	No	Yes	No
Luxembourg	Yes	0	100	N/A	N/A	Yes	No	No	No
FYR Macedonia	Yes	10	80	10	10	Yes	No	No	No

Continued

Table 3 Continued

Country	Basic insurance availability	Uninsured citizens (% of population)	Distribution of insurance modality (%)			Possibility to subscribe private health insurance plans	Co-payment necessary for EP therapies		
			Public insurance	Private insurance	Private co-payment		ICD	PM	Ablation
Malta	Yes	0	100	0	0	Yes	No	No	No
Moldova	Yes	20	100	0	0	Yes	N/A	No	N/A
Montenegro	Yes	N/A	100	0	0	No	No	No	No
Morocco	No	35	70	25	5	Yes	Yes	Yes	Yes
Netherlands	Yes	0	0	100	0	No	No	No	No
Norway	Yes	0	97	N/A	3	Yes	No	No	No
Poland	Yes	5	90	5	5	Yes	No	No	No
Portugal	N/A	0	100	0	0	Yes	No	No	No
Romania	Yes	N/A	98	0	2	Yes	Yes	No	Yes
Russian Federation	Yes	N/A	85	10	5	Yes	No	Yes	No
San Marino	No	0	100	N/A	0	Yes	No	No	No
Serbia	Yes	5	90	5	5	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	75	10	15	Yes	No	No	No
Sweden	Yes	0	N/A	N/A	N/A	Yes	No	No	No
Switzerland	Yes	0	70	0	30	Yes	No	No	No
Syria ^a									
Tunisia ^a									
Turkey ^a									
Ukraine	No	N/A	N/A	N/A	N/A	Yes	No	No	No
United Kingdom	No	90	90	10	0	Yes	No	No	No

^aThese 7 countries did not submit data for the EHRA White Book 2014.

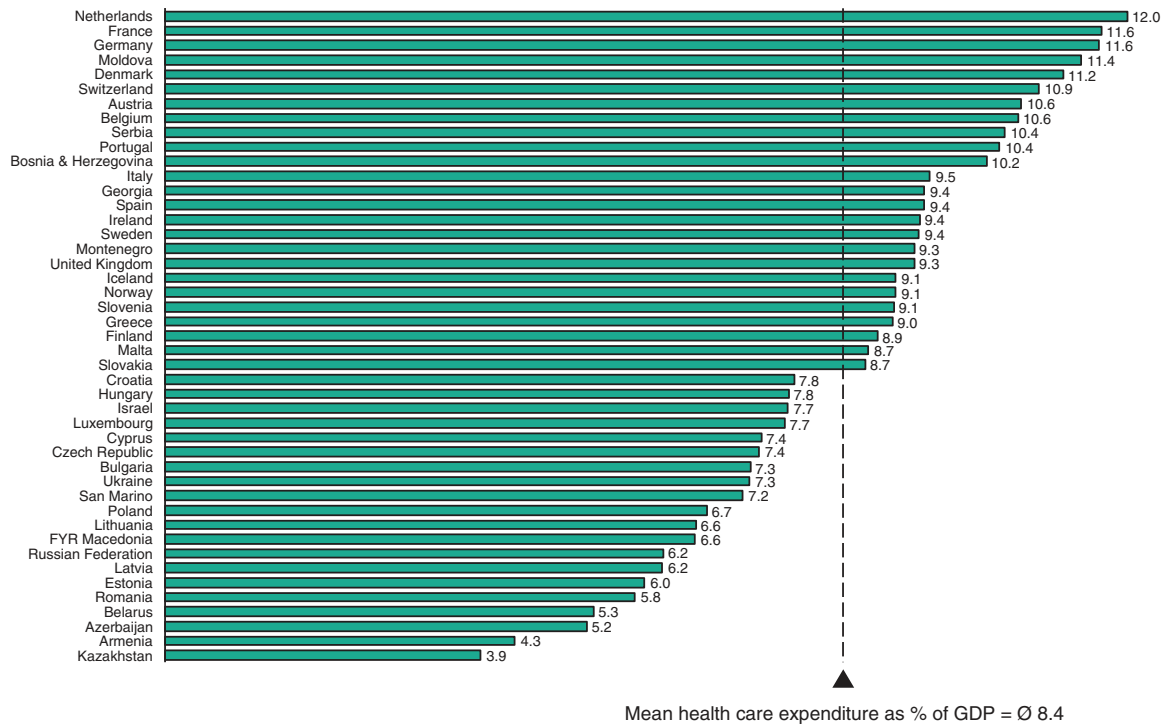


Figure 2 Healthcare expenditure as percentage of national gross domestic product (GDP) in the European Society of Cardiology countries in 2011. Mean number of % of expenditure is weighted by population.

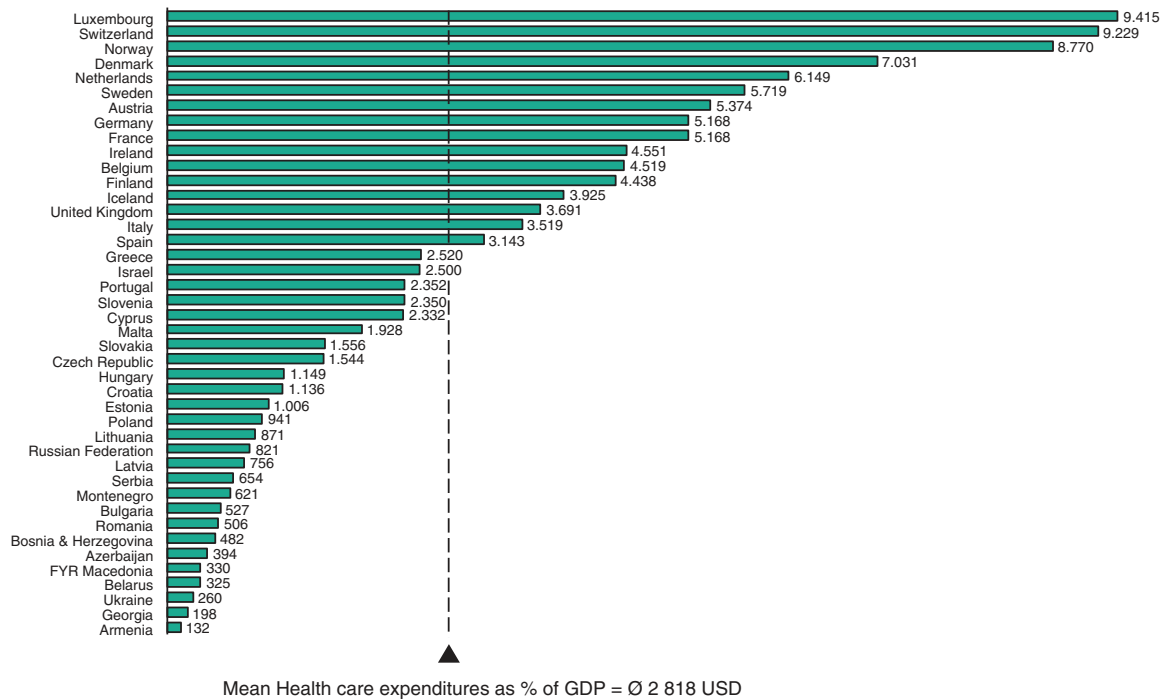


Figure 3 Healthcare expenditure per capita in the European Society of Cardiology countries in 2011. Mean number of expenditure is weighted by population.

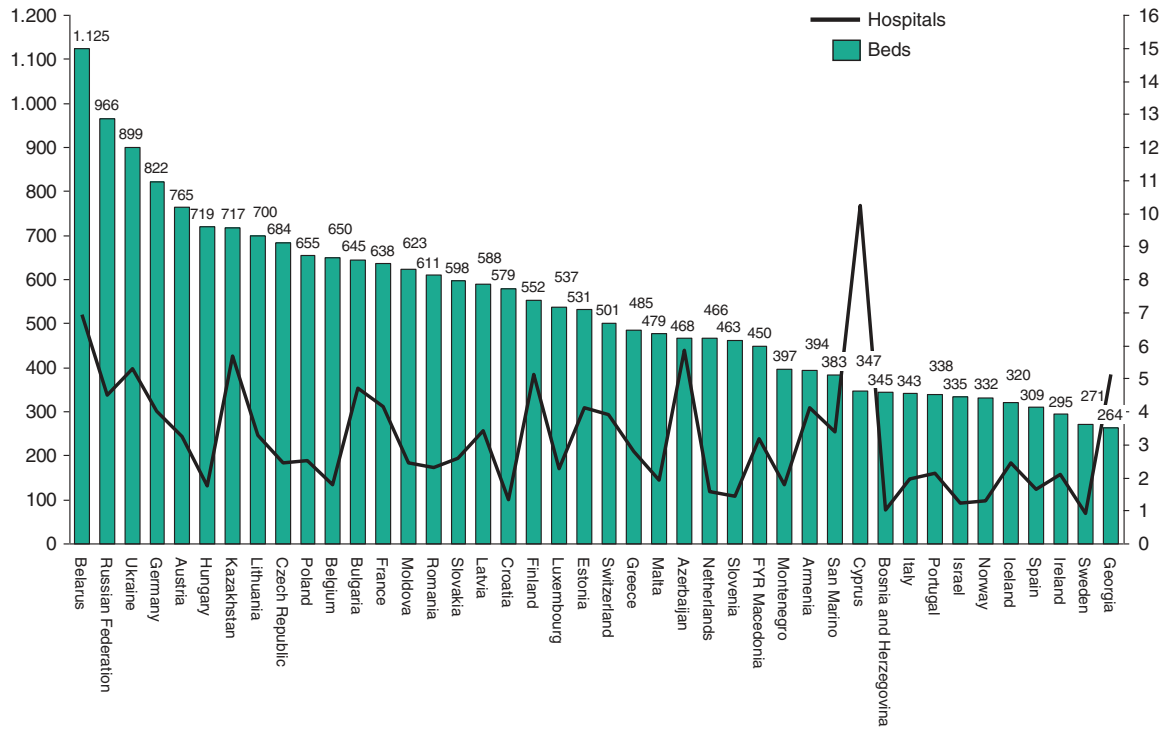


Figure 4 Hospitals and hospital beds per 100,000 inhabitants in the European Society of Cardiology countries.

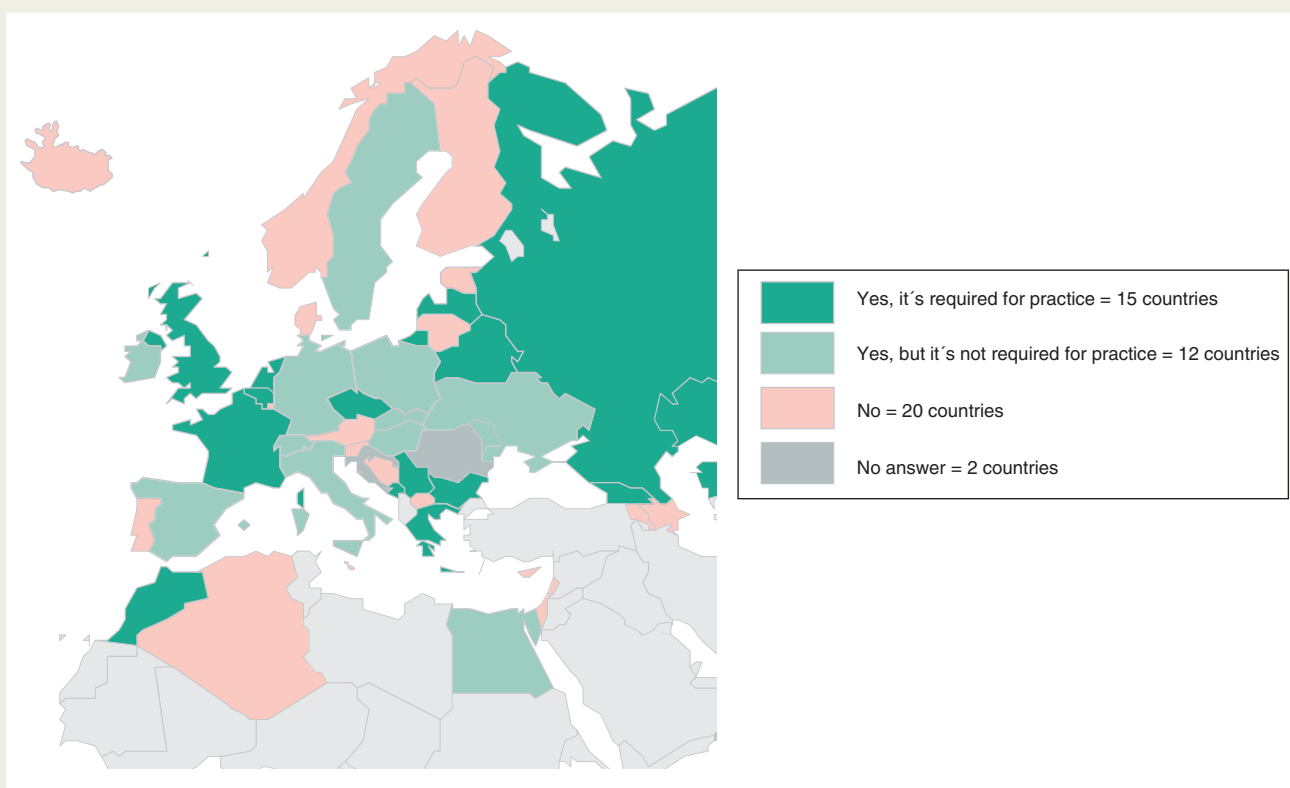


Figure 5 Certification for cardiac implantable electronic device (CIED) therapy in the European Society of Cardiology countries in 2013.

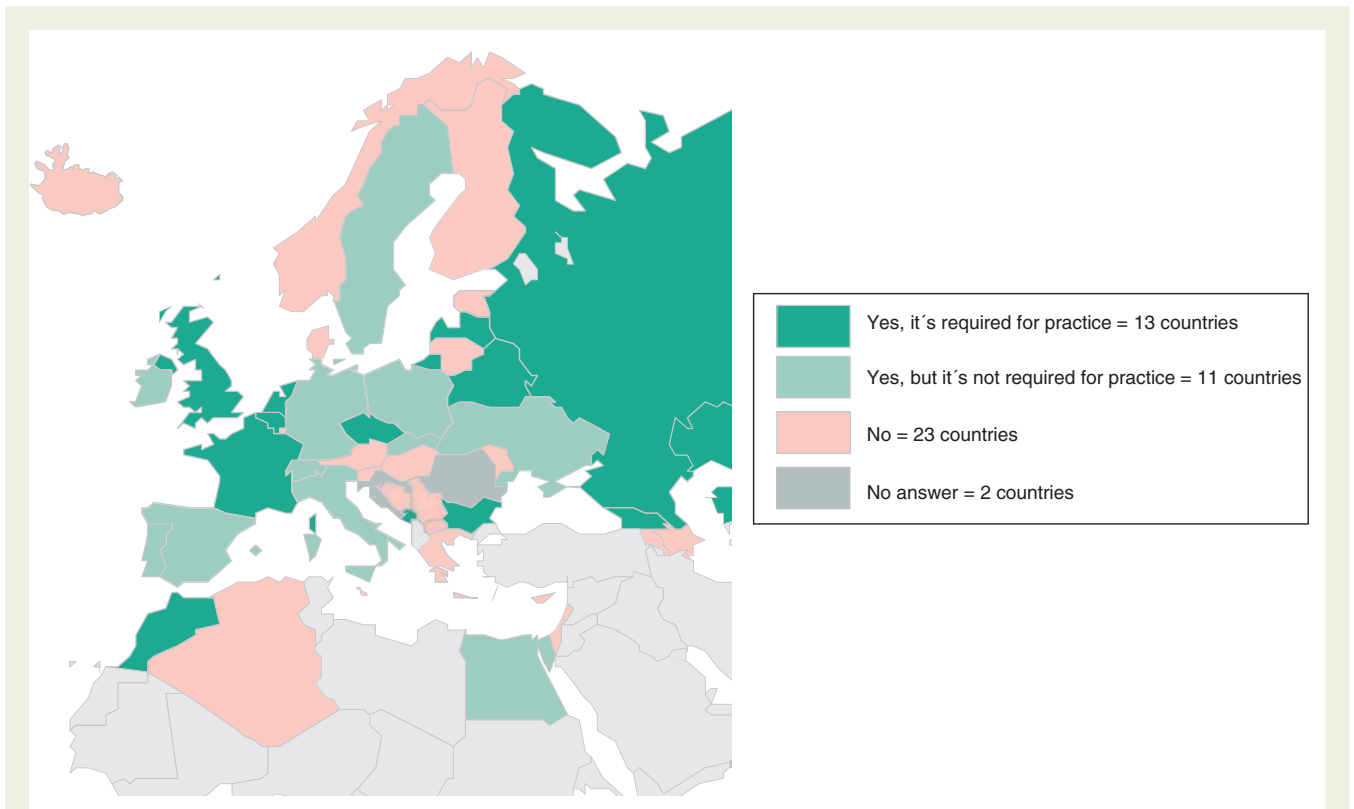


Figure 6 Certification for invasive electrophysiology in the European Society of Cardiology countries in 2013.

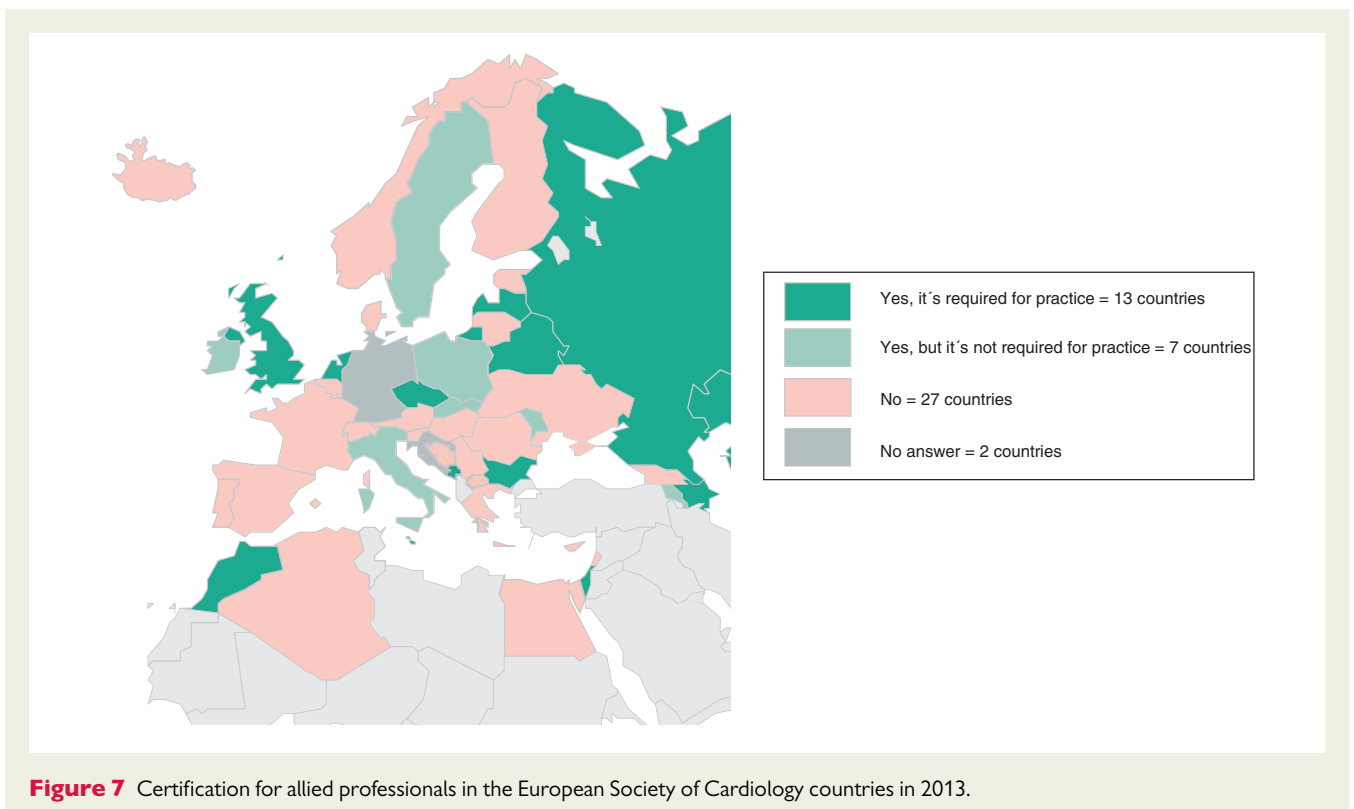


Figure 7 Certification for allied professionals in the European Society of Cardiology countries in 2013.

hoped that these data will help clarify whether financial restrictions influence the delivery of arrhythmia care. 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).

In 2013 the economic situation in the ESC area was characterized by ongoing financial difficulties following the recent economic crisis and substantial budget cuts for healthcare.^{3,4} At the same time the number of elderly people, who require vast medical and social assistance, is growing rapidly. In this context, socioeconomic disparities pose major threats to healthcare systems. These aspects have an important negative impact on the use of expensive innovative technology such as CIED therapy for primary prevention of sudden cardiac death and catheter ablation therapies.^{5–8}

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.⁹ Demographic and GDP data reveal some important differences between the ESC countries. As an example, the life expectancy varied from 68.9 years (Ukraine) to 83.1 years (San Marino). 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 3.593 (Germany) trillion US dollars (USD). The GDP per capita was almost 100 times higher in Luxembourg (110.573 USD) than in Kyrgyzstan (1.282 USD). Given these huge

financial disparities, it was not surprising at all that there were large variations in device implantation rates and use of catheter ablation therapies across the ESC regions and between countries.

Healthcare resources

Health 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 8.4% of the GDP. It was highest in the Netherlands (12.0%) and lowest in Kazakhstan (3.9%). Given the trend towards a progressive ageing of populations, it is likely that the healthcare expenditure will continue to increase. The mean health expenditure per capita in the ESC area was 2818 USD, ranging from 132 USD in Armenia to 9.415 USD in Luxembourg. Hence, there was more than 70-fold difference between the lowest and the highest health expenditure per capita.

The number of hospitals and hospital beds available for healthcare are 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 EP procedures (Table 3). In countries in which 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

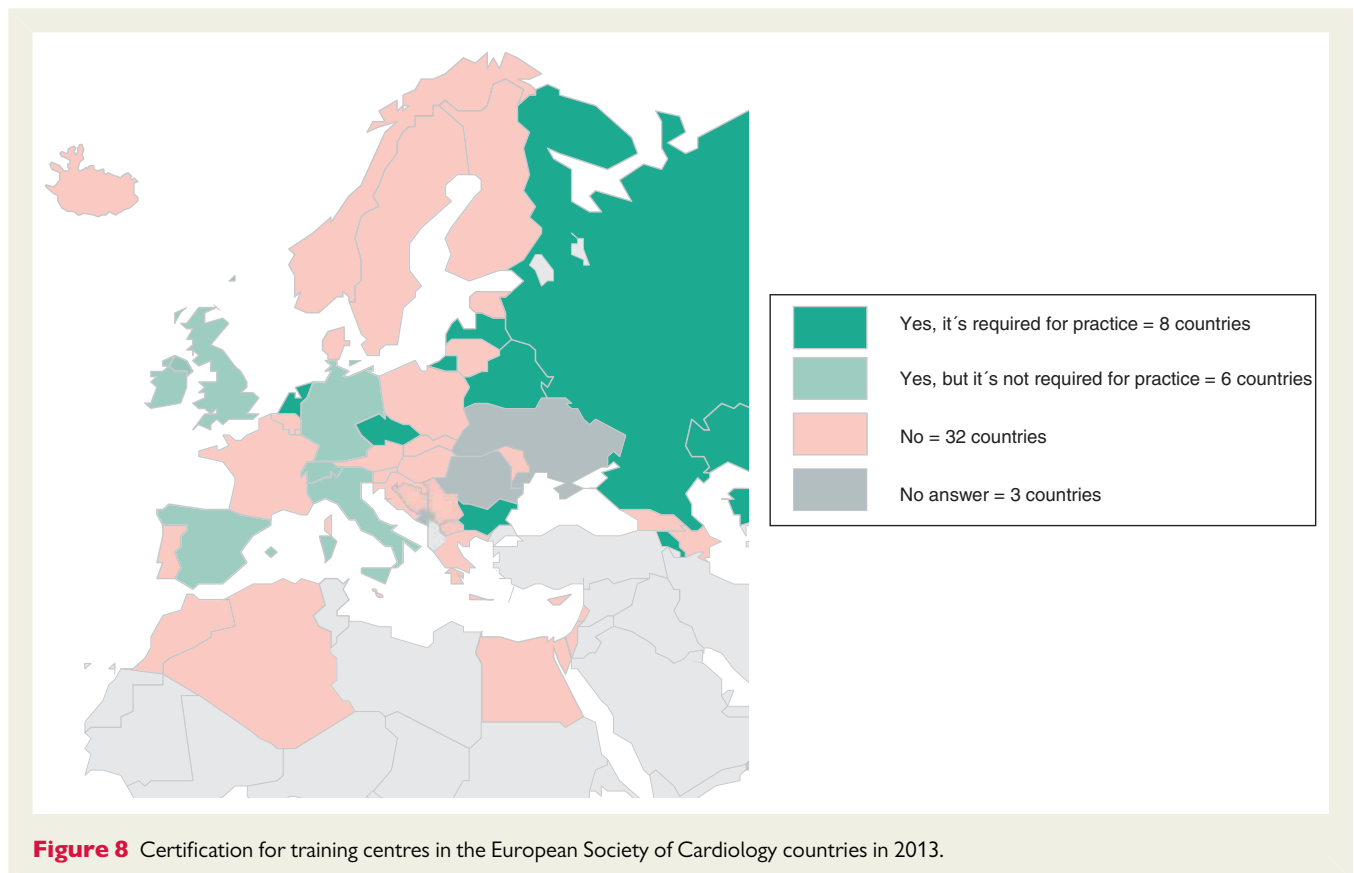


Figure 8 Certification for training centres in the European Society of Cardiology countries in 2013.

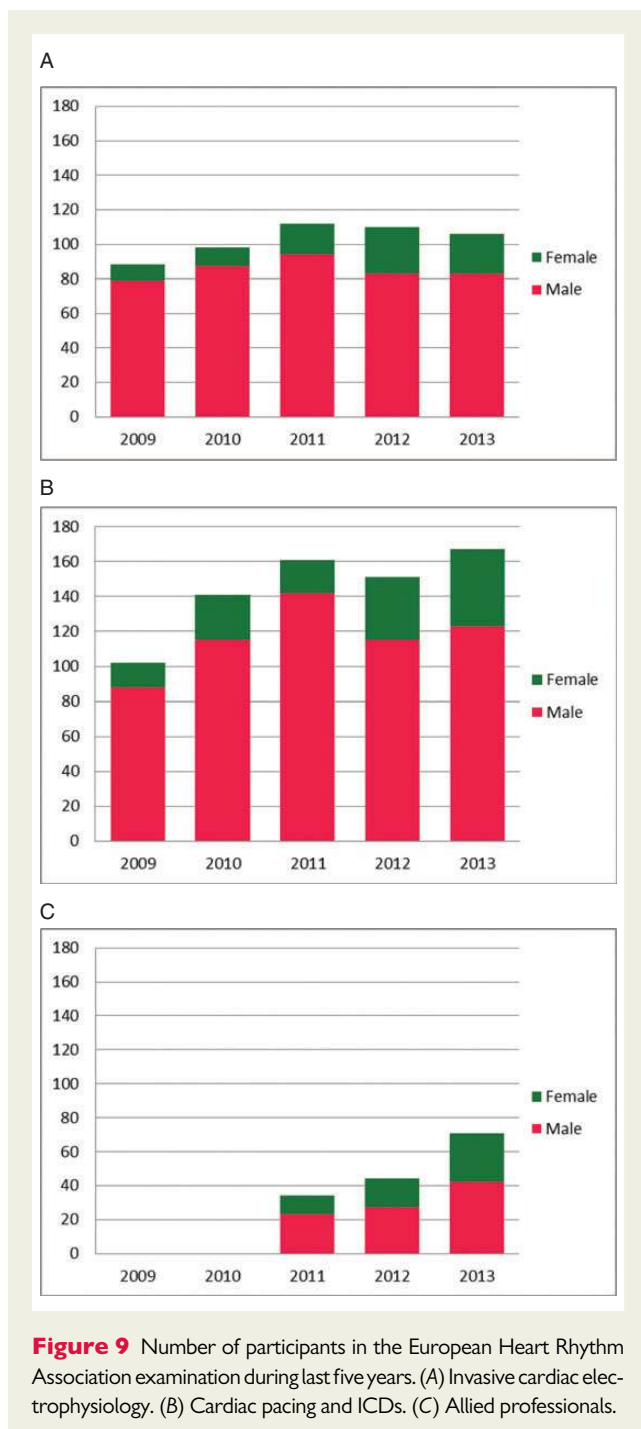


Figure 9 Number of participants in the European Heart Rhythm Association examination during last five years. (A) Invasive cardiac electrophysiology. (B) Cardiac pacing and ICDs. (C) Allied professionals.

countries are heterogeneous, the impact of co-payment to implementation of interventional electrophysiological procedures in clinical practice is difficult to estimate.

Certification of professional excellence

General information

In 2013, 47 countries (85% 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 2014.¹⁰ A national certification programme for device therapy for physicians was in use in 27 countries and certification was mandatory in 15 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 20 countries and was required for practice in 9 countries. Training centres were accredited in only 14 (25%) countries, and certification of training centres was mandatory in order to train fellows in eight countries (Figure 8). Many centres in various regions have been available as training centres for the EHRA fellows and allowed many young physicians from emerging economies to be trained in high volume centres abroad.

EHRA 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. Since 2006 a total of 1629 physicians (972 in cardiac pacing and ICDs and 657 in invasive cardiac electrophysiology) from 34 countries have participated in the EHRA examination. In 2013, the majority of them (75%) were male and most of them were 31–40 years of age. However, over the years, the proportion of female candidates has increased from about 10% to 25% (Figure 9). The highest number of candidates participating in the cardiac device therapy examination was from the Netherlands, followed by Spain and Germany. For EP, the highest numbers of participants were from Spain, Italy, Germany, United Kingdom, and the Netherlands.

The pass rate for physicians participating in the invasive EP examination was 62% and 71% for the cardiac device therapy examination. These numbers are similar to the pass rates from previous years. Since the introduction of the EHRA examination, 887 physicians (582 in cardiac device therapy and 305 in invasive EP) have passed the examination 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, 103 candidates from eight countries have participated in the EHRA examination and 84 have achieved full certification. Last year the pass rate in the allied professional examination was 61%, which is similar to the previous years. Every year, most participants have been from the Netherlands followed by Greece, Spain, and United Kingdom. For allied professionals the examination was 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. In 2013, the EHRA certification programme was acknowledged by 34 ESC countries, but it was an obligatory requirement for practice in only two countries. Accordingly, there is an urgent need to involve more physicians and allied professionals in the EHRA certification system to assure uniform and high

Latvia	LV	Yes	3	1.38	1288	591	–	1823	450	490	550	548	591
Lebanon	LB	No	15	3.63	900	218	2197	3458	N/A	N/A	N/A	N/A	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	1.14	2716	772	–	2942	662	716	714	756	772
Luxembourg	LU	No	5	9.71	188	365	274	431	200	179	336	621	365
FYR Macedonia	MK	Yes	2	0.96	322	154	1110	1747	119	150	174	166	154
Malta	MT	Yes	2	4.86	227	552	–	344	675	686	740	644	552
Moldova	MD	No	1	0.28	287	79	1925	3029	N/A	N/A	N/A	N/A	79
Montenegro	ME	No	1	1.53	204	312	347	547	253	257	264	218	312
Morocco	MA	Yes	11	0.34	1109	34	17 360	27 324	N/A	35	39	38	34
Netherlands	NL	Yes	90	5.36	10 174	605	–	14 064	N/A	600	585	560	605
Norway	NO	Yes	23	4.52	3459	680	–	4256	630	678	675	691	680
Poland	PL	No	145	3.78	27 500	716	–	32 123	713	719	710	716	716
Portugal	PT	Yes	40	3.70	8790	814	–	9038	686	764	595	825	814
Romania	RO	Yes	22	1.01	2400	110	11 586	18 236	140	117	139	144	110
Russian Federation	RU	Yes	140	0.98	34 758	244	75 768	119 257	186	188	216	212	244
San Marino	SM	Yes	1	30.82	14	431	17	27	380	688	503	809	431
Serbia	RS	Yes	18	2.49	3958	546	–	6062	446	437	448	431	546
Slovakia	SK	Yes	14	2.55	3456	630	–	4593	513	548	617	567	630
Slovenia	SI	Yes	8	4.01	1287	646	–	1668	458	568	647	668	646
Spain	ES	Yes	230	4.86	35 500	749	–	39 644	747	762	734	738	749
Sweden	SE	Yes	42	4.35	9602	995	–	–	983	973	N/A	1041	995
Switzerland	CH	Yes	76	9.50	6097	763	–	6692	713	741	791	753	763
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 ^a	TN	N/A	N/A	N/A	N/A	N/A	N/A	N/A	146	143	155	233	N/A
Turkey ^a	TR	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Ukraine	UA	No	36	0.81	6579	148	23 700	37 303	85	103	112	121	148
United Kingdom	GB	Yes	227	3.58	44 503	702	–	53 055	645	600	610	615	702
Total ESC countries	56		3580		500 411								

^aThese seven countries did not submit data on PM implantation for the EHRA White Book 2014.

Table 5 Specialty of the physicians performing device implantations and lead extractions 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 lead extractions (%)		
		Cardiologists	Surgeons	Other	Cardiologists	Surgeons	Other	Cardiologists	Surgeons	Other	Cardiologists	Surgeons	Other	Cardiologists	Surgeons	Other
Albania ^a	AL	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
Algeria	DZ	99	1	0	100	0	0	100	0	0	100	0	0	N/A	N/A	N/A
Armenia	AM	100	0	0	100	0	0	100	0	0	100	0	0	100	0	0
Austria	AT	50	50	0	10	90	0	50	50	0	80	20	0	10	90	0
Azerbaijan	AZ	52	48	0	100	0	0	100	0	0	100	0	0	90	10	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	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Bosnia & Herzegovina	BA	50	35	15	95	5	0	100	0	0	100	0	0	0	0	0
Bulgaria	BG	99.0	1.0	0	100	0	0	100	0	0	100	0	0	100	0	0
Croatia	HR	88	12	0	65	35	0	100	0	0	100	0	0	N/A	N/A	N/A
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	95	5	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	60	10	30	65	0	35	65	0	35	90	0	10	80	0	20
Estonia	EE	100	0	0	100	0	0	100	0	0	100	0	0	N/A	N/A	N/A
Finland	FI	95	5	0	100	0	0	100	0	0	100	0	0	N/A	N/A	N/A
France	FR	95	5	0	100	0	0	95	5	0	100	0	0	80	20	0
Georgia	GE	90	10	0	100	0	0	100	0	0	100	0	0	N/A	N/A	N/A
Germany	DE	70	20	10	70	20	10	100	0	0	80	20	0	50	50	0
Greece	GR	97	3	0	98	2	0	98	2	0	100	0	0	90	10	0
Hungary	HU	90	5	5	90	5	5	95	2	3	100	0	0	100	0	0
Iceland	IS	100	0	0	100	0	0	100	0	0	100	0	0	0	0	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	98	2	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	53	47	0	55	45	0	53	47	0	47	53	0	43	57	0
Kosovo ^a	XK	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
Kyrgyzstan ^a	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	20	80	0

Lebanon	LB	75	20	5	75	20	5	90	5	5	50	50	0	100	0	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	100	0	0
Luxembourg	LU	95	5	0	100	0	0	90	10	0	100	0	0	0	100	0
FYR Macedonia	MK	100	0	0	100	0	0	100	0	0	100	0	0	33	67	0
Malta	MT	100	0	0	100	0	0	100	0	0	100	0	0	0	0	0
Moldova	MD	100	0	0	0	0	0	0	0	0	0	0	0	100	0	0
Montenegro	ME	50	50	0	50	50	0	100	0	0	50	50	0	50	50	0
Morocco	MA	99	1	0	99	1	0	100	0	0	N/A	N/A	N/A	90	10	0
Netherlands	NL	90	5	5	90	5	5	95	0	5	80	0	20	90	10	0
Norway	NO	100	0	0	100	0	0	100	0	0	100	0	0	100	0	0
Poland	PL	99	1	0	100	0	0	100	0	0	100	0	0	80	20	0
Portugal	PT	99	1	0	100	0	0	100	0	0	100	0	0	50	50	0
Romania	RO	99	1	0	99	1	0	100	0	0	100	0	0	90	10	0
Russian Federation	RU	70	30	0	60	40	0	50	50	0	N/A	N/A	N/A	50	50	0
San Marino	SM	100	0	0	100	0	0	100	0	0	100	0	0	0	0	0
Serbia	RS	100	0	0	100	0	0	100	0	0	100	0	0	80	20	0
Slovakia	SK	65	35	0	100	0	0	100	0	0	100	0	0	98	2	0
Slovenia	SI	10	90	0	5	95	0	100	0	0	50	50	0	0	100	0
Spain	ES	70	25	5	81	14	5	90	10	0	N/A	N/A	N/A	15	85	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	90	10	0	98	2	0	95	5	0	N/A	N/A	N/A	40	60	0
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 ^a	TN	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
Turkey ^a	TR	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
Ukraine	UA	10	90	0	18	82	0	18	82	0	50	50	0	0	100	0
United Kingdom	GB	98	2	0	98	2	0	98	2	0	100	0	0	N/A	N/A	N/A

^aThese seven countries did not submit data for the EHRA White Book 2014.

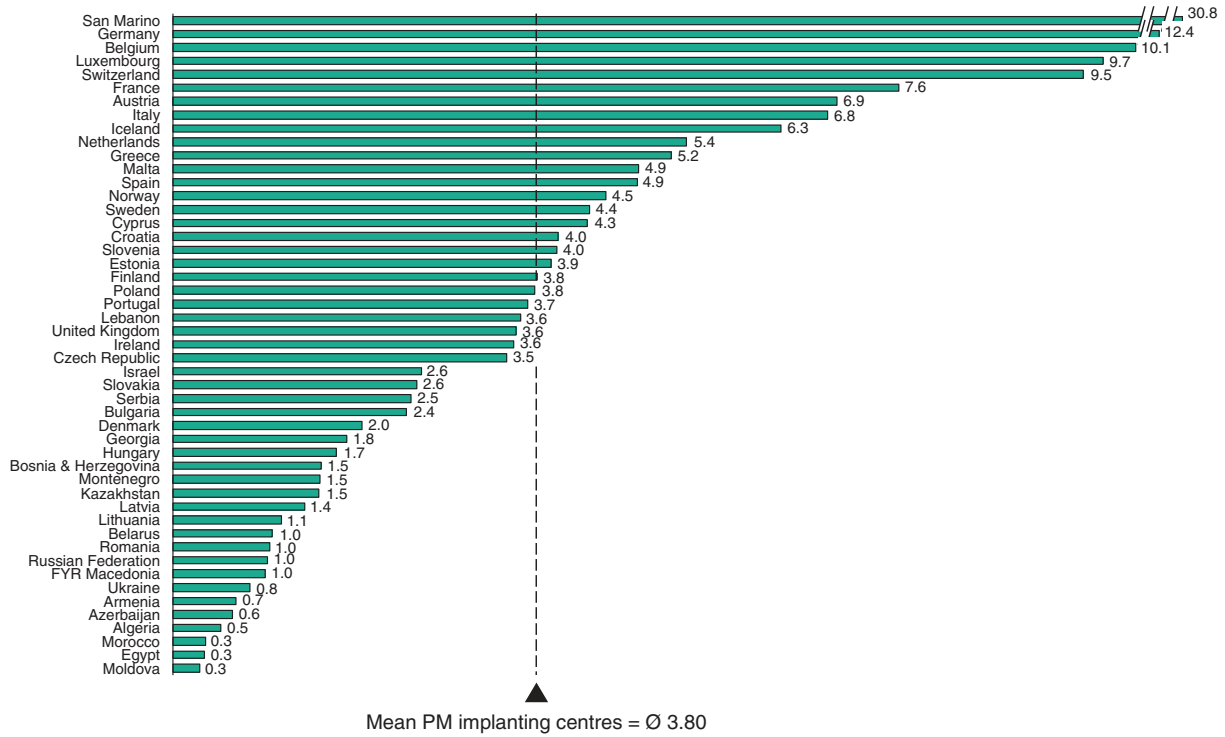


Figure 10 Number of pacemaker (PM) implanting centres per mil inhabitants in the European Society of Cardiology countries in 2013. Mean number of implantation centres is weighted by population.

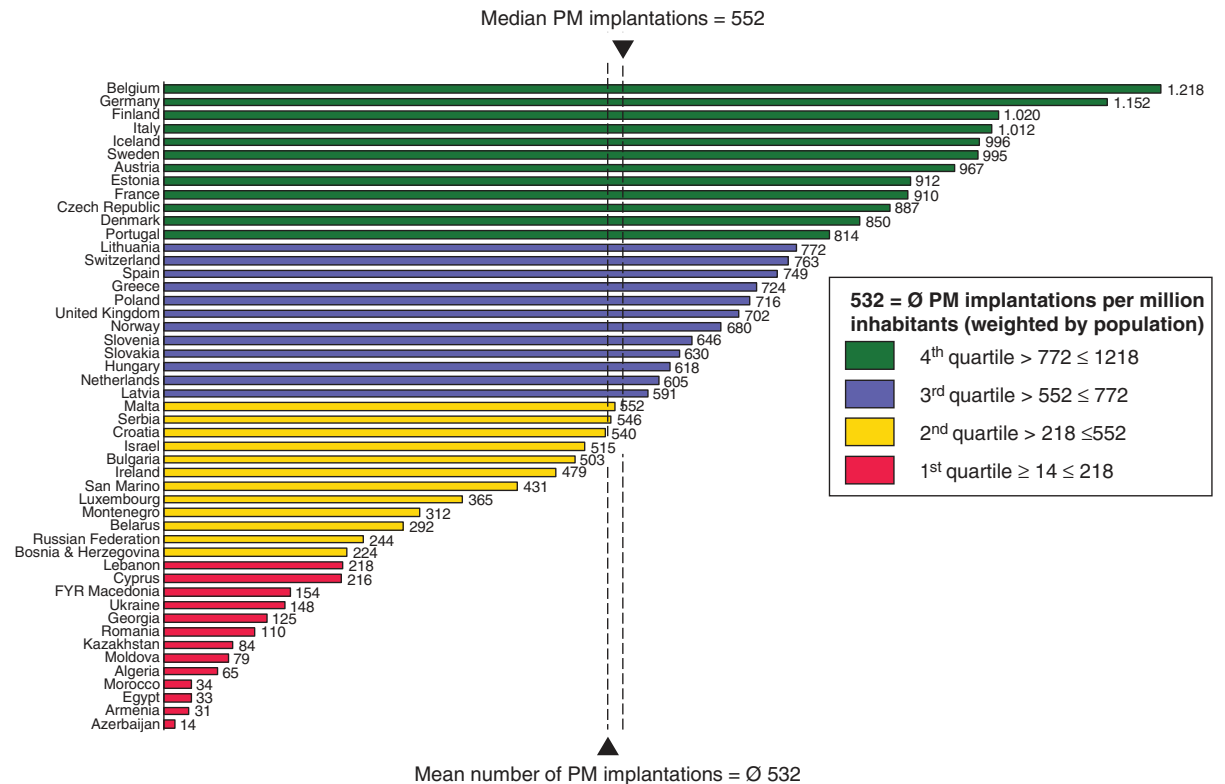


Figure 11 Pacemaker (PM) implantations per million inhabitants 2013.

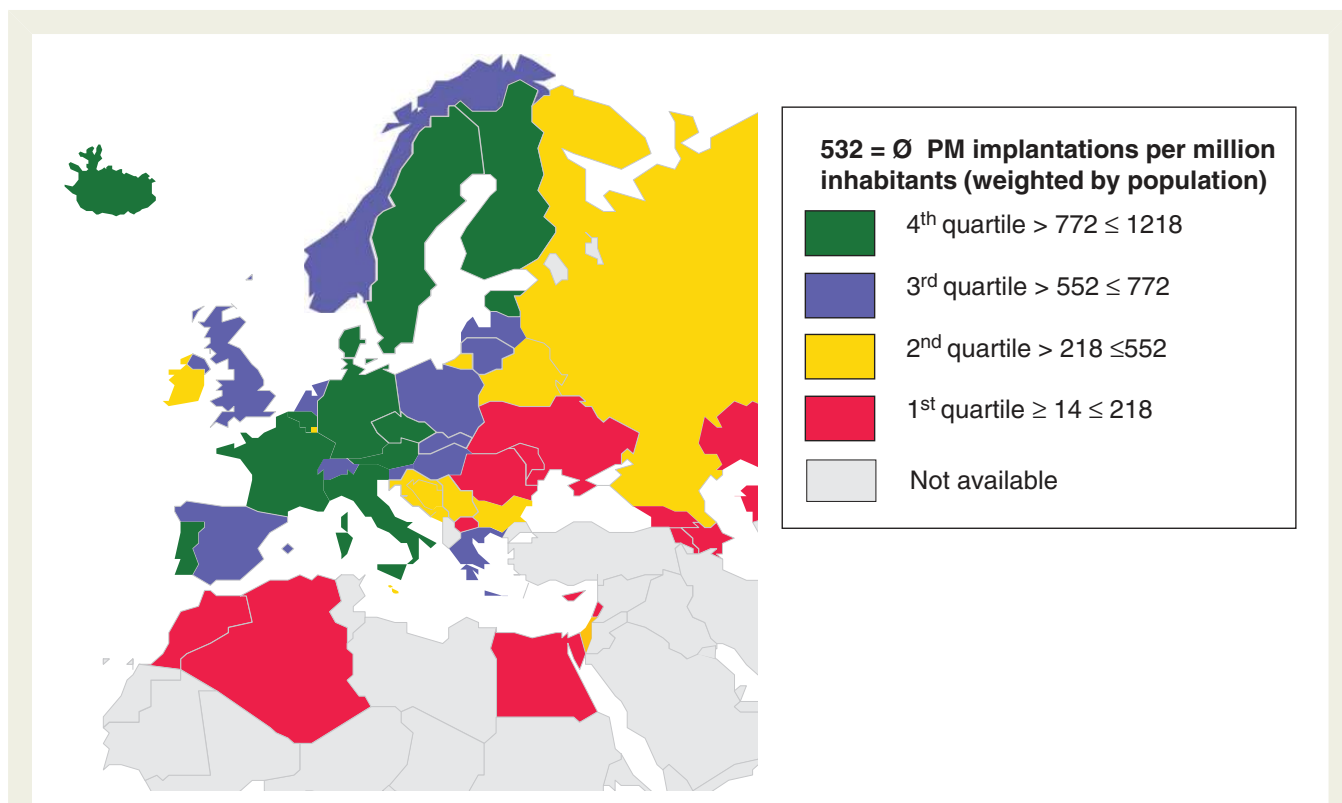


Figure 12 Pacemaker implantations in the European Society of Cardiology countries in 2013.

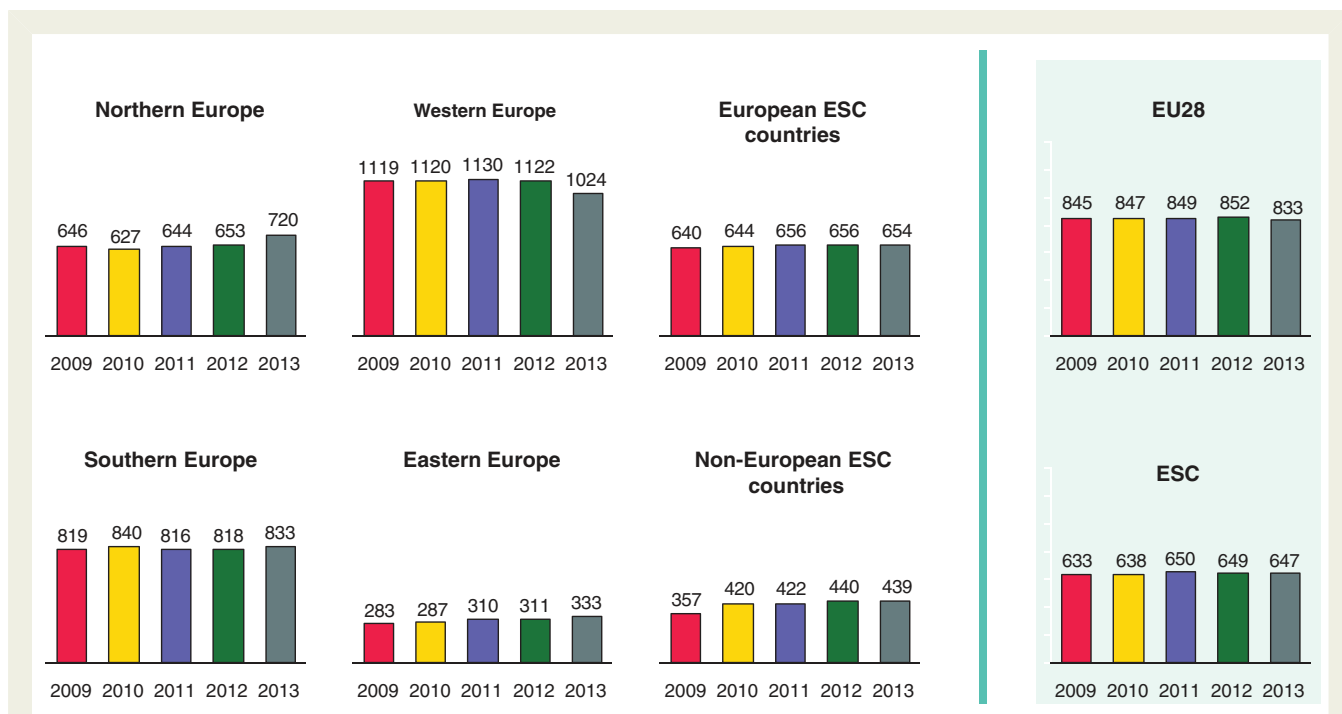
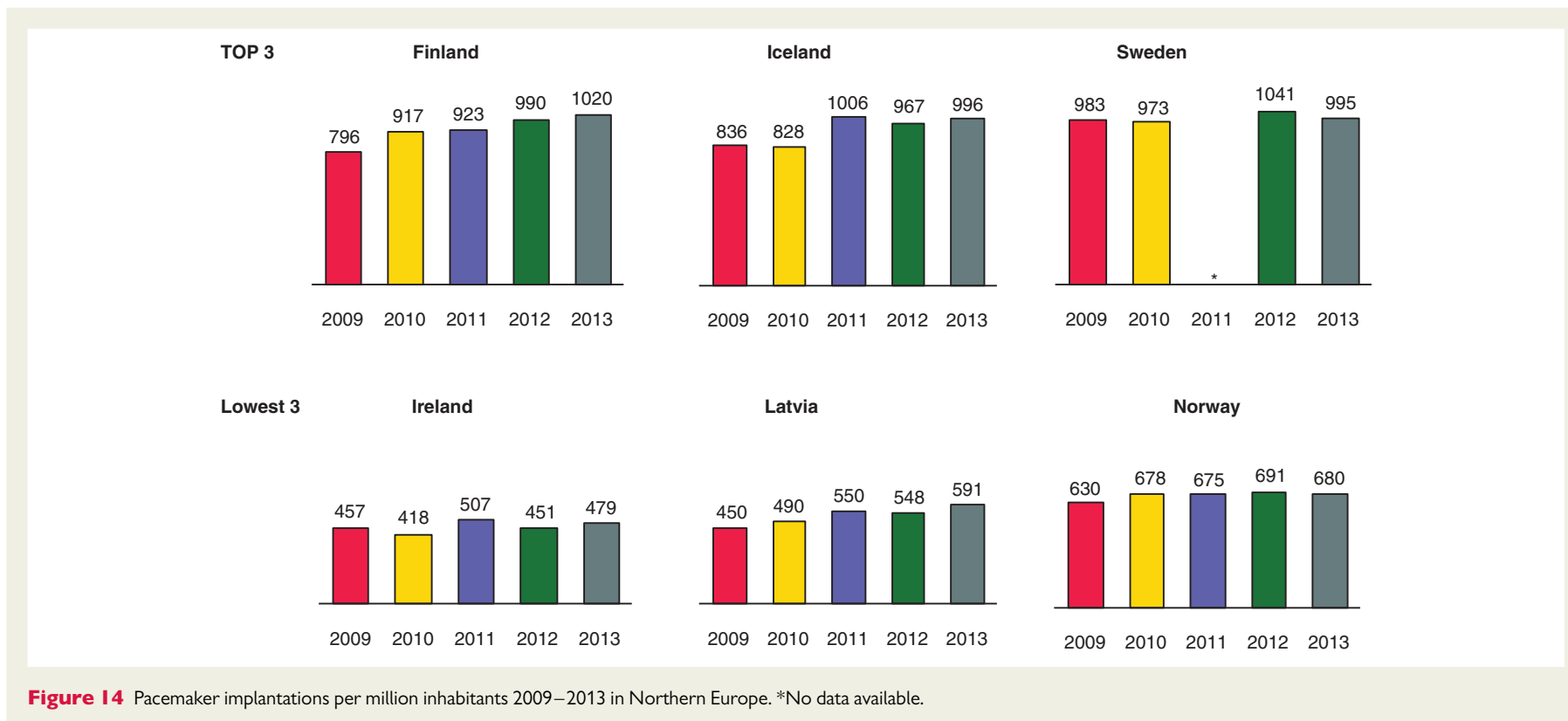


Figure 13 Pacemaker implantations per million inhabitants 2009–2013 in the five geographical regions of the European Society of Cardiology (ESC) and comparison to the total ESC area and the 28 member countries of the European Union (EU28).



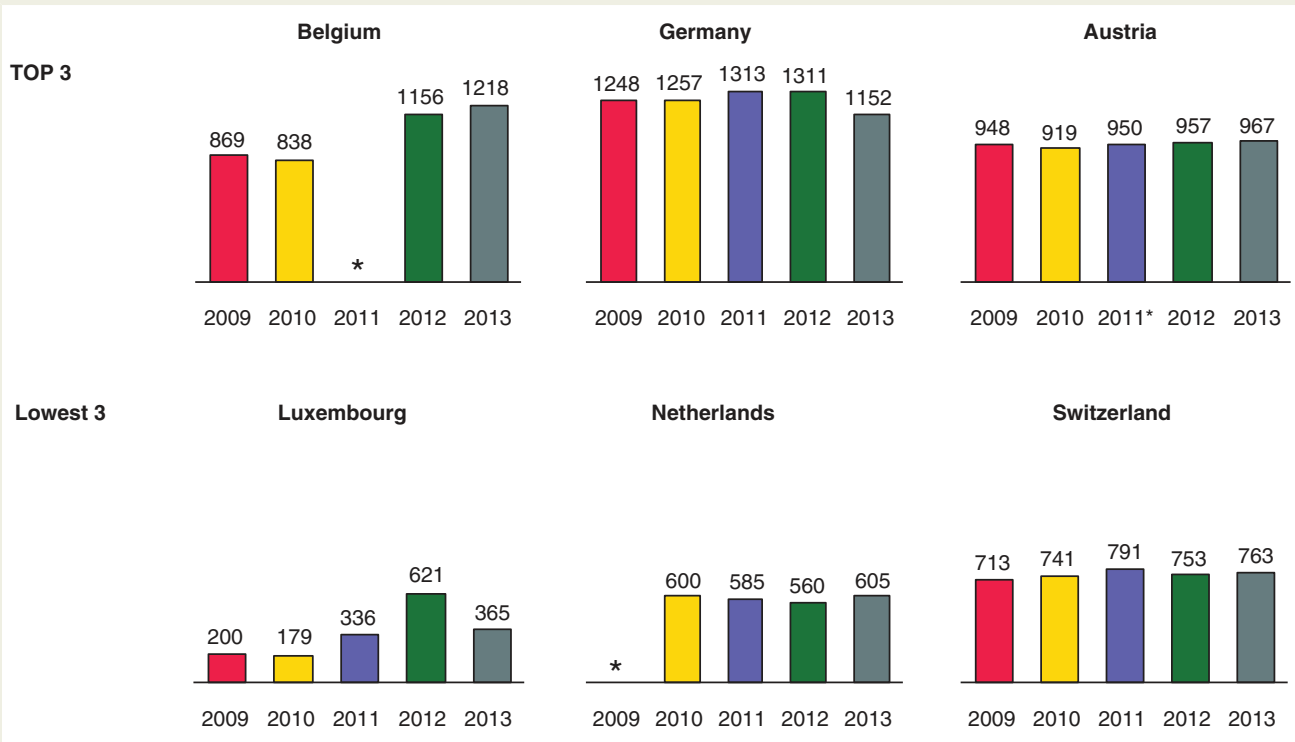


Figure 15 Pacemaker implantations per million inhabitants 2009–2013 in Western Europe. *No data available.

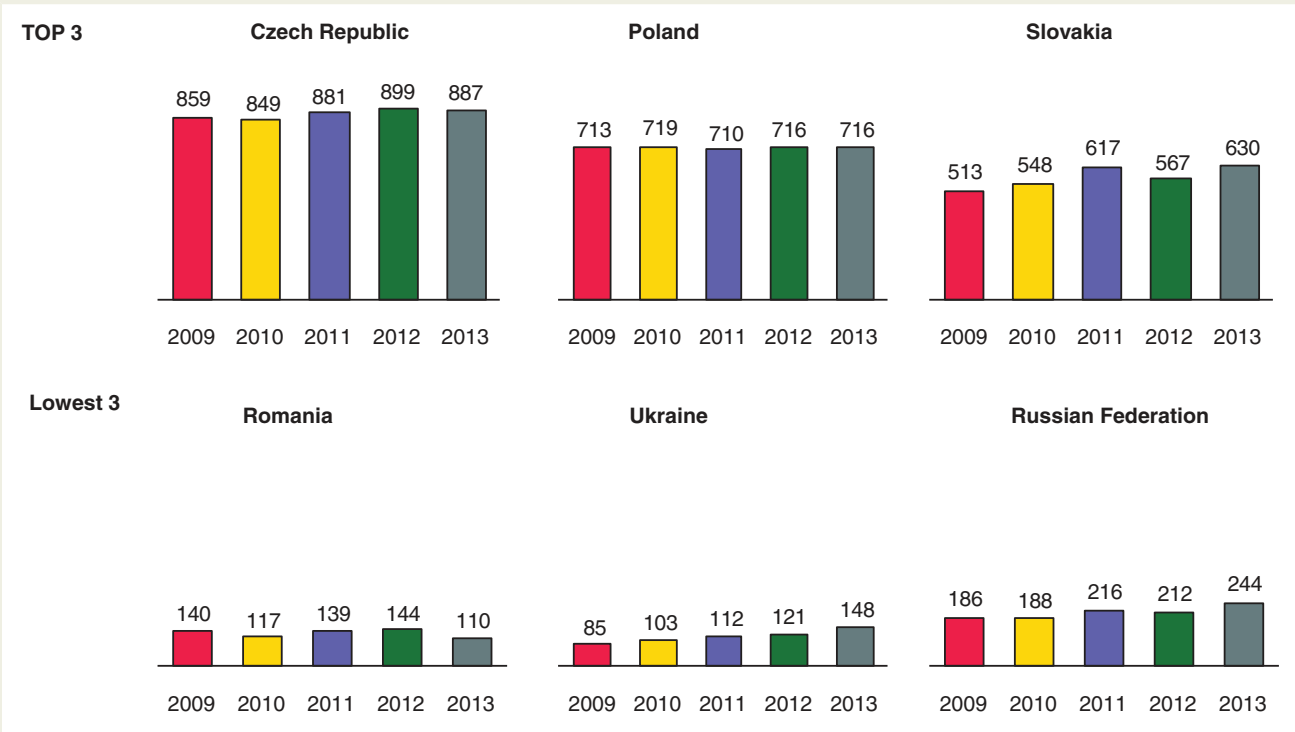


Figure 16 Pacemaker implantations per million inhabitants 2009–2013 in Eastern Europe.

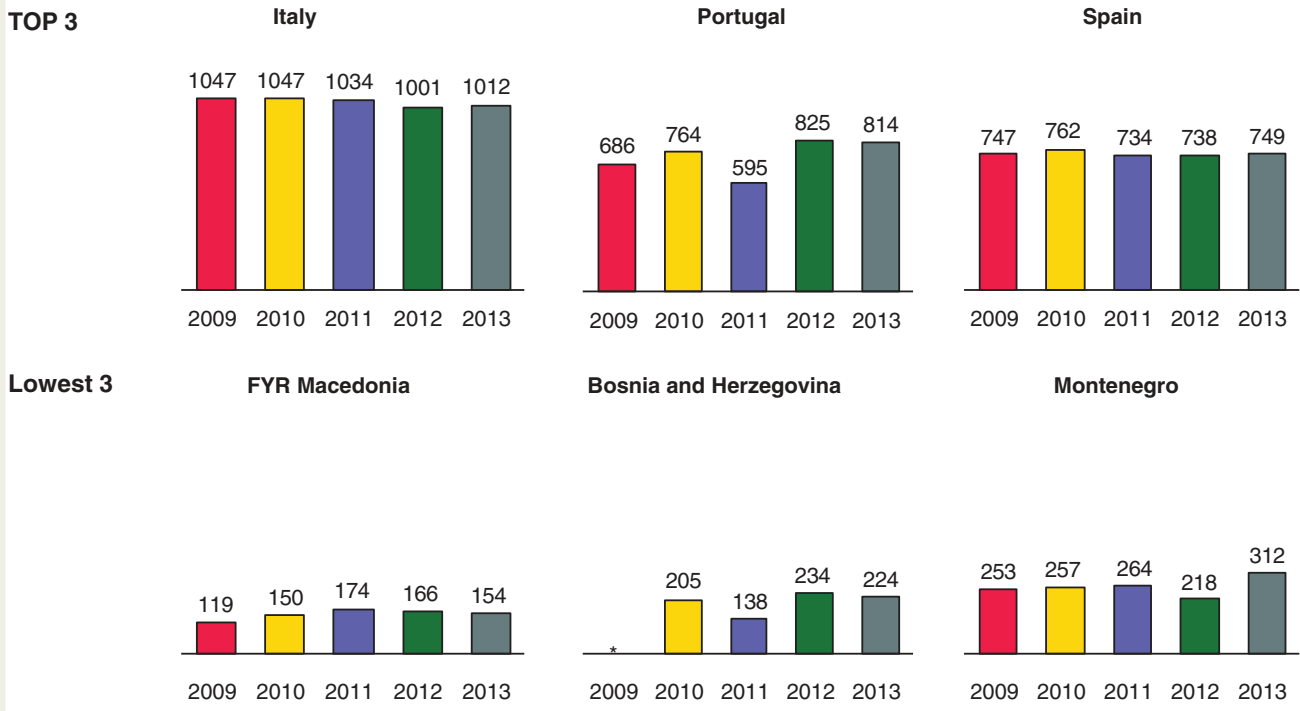


Figure 17 Pacemaker implantations per million inhabitants 2009–2013 in Southern Europe. *No data available.

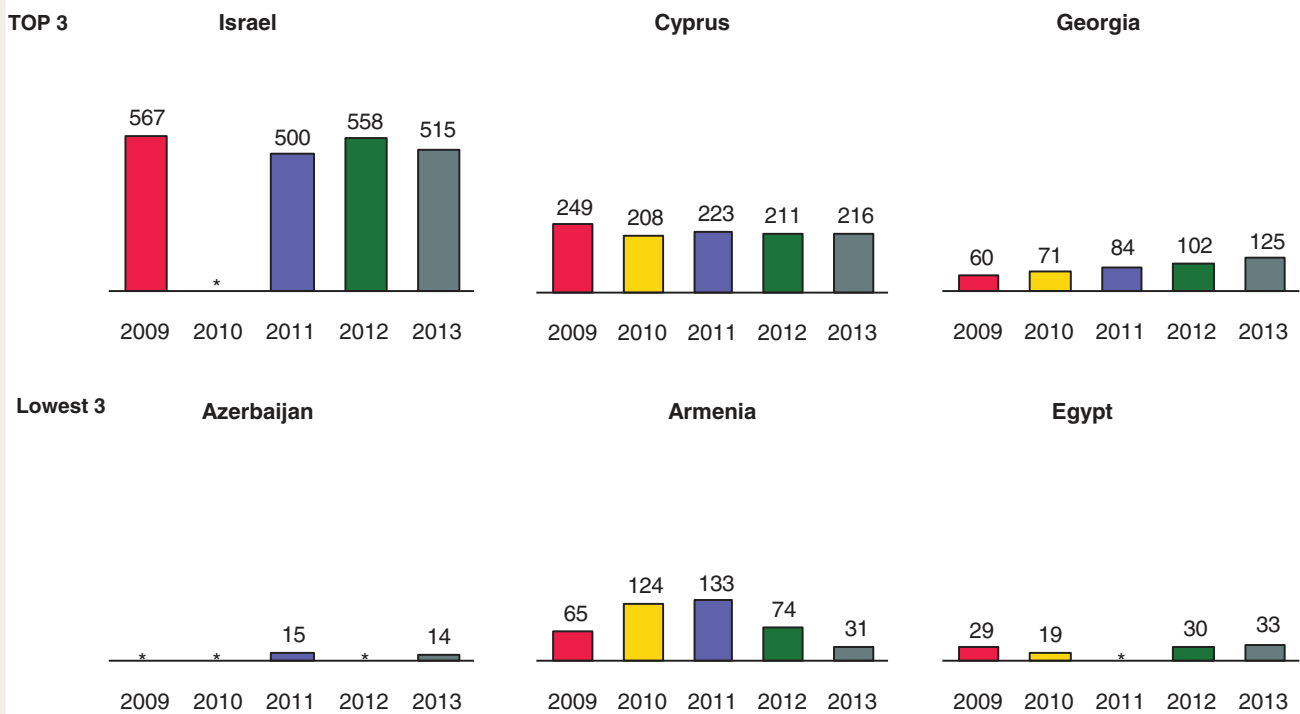


Figure 18 Pacemaker implantations per million inhabitants 2009–2013 in the non-European European Society of Cardiology (ESC) countries. *No data available.

Table 6 Changes in pacemaker implantation centres in year 2012 vs. 2013

Country	ISO code	Number of PM implanting centres 2012		Number of PM implanting centres 2013		Change %
		Absolute number	Per mil inhabitants	Absolute number	Per mil inhabitants	
Albania ^a	AL	N/A	N/A	N/A	N/A	N/A
Algeria	DZ	N/A	N/A	19	0.50	N/A
Armenia	AM	3	1.01	2	0.65	–35%
Austria	AT	57	6.93	57	6.93	0%
Azerbaijan	AZ	N/A	N/A	6	0.63	N/A
Belarus	BY	10	1.04	10	1.04	0.2%
Belgium	BE	103	9.29	105	10.05	8.2%
Bosnia & Herzegovina	BA	6	1.55	6	1.55	0.1%
Bulgaria	BG	17	2.42	17	2.43	1%
Croatia	HR	17	3.79	18	4.02	6%
Cyprus	CY	5	4.39	5	4.33	–2%
Czech Republic	CZ	37	3.64	37	3.49	–4.1%
Denmark	DK	9	1.62	11	1.98	22%
Egypt	EG	28	0.33	28	0.33	–1.9%
Estonia	EE	5	3.92	5	3.95	1%
Finland	FI	20	3.80	20	3.80	0%
France	FR	474	7.22	500	7.58	5%
Georgia	GE	9	1.97	9	1.82	–8%
Germany	DE	1048	12.89	1010	12.45	–3%
Greece	GR	56	5.20	56	5.20	0.0%
Hungary	HU	16	1.61	17	1.71	6.5%
Iceland	IS	1	3.19	2	6.34	99%
Ireland	IE	17	3.60	17	3.56	–1%
Israel	IL	18	2.37	20	2.60	9%
Italy	IT	400	6.53	420	6.83	4.6%
Kazakhstan	KZ	22	1.26	27	1.52	21%
Kosovo ^a	XK	N/A	N/A	N/A	N/A	N/A
Kyrgyzstan ^a	KGZ	0	0	N/A	N/A	N/A
Latvia	LV	3	1.37	3	1.38	0.6%
Lebanon	LB	N/A	N/A	15	3.63	N/A
Libya ^a	LY	N/A	N/A	N/A	N/A	N/A
Lithuania	LT	4	1.13	4	1.14	0.3%
Luxembourg	LU	5	9.82	5	9.71	–1.1%
FYR Macedonia	MK	3	1.44	2	0.96	–33.5%
Malta	MT	2	4.88	2	4.86	–0.4%
Moldova	MD	N/A	N/A	1	0.28	N/A
Montenegro	ME	1	1.52	1	1.53	0.6%
Morocco	MA	11	0.34	11	0.34	–1.0%
Netherlands	NL	90	5.38	90	5.36	–0.4%
Norway	NO	23	4.60	23	4.52	–1.7%
Poland	PL	132	3.44	145	3.78	9.9%
Portugal	PT	42	4	40	3.70	–4.9%
Romania	RO	21	0.96	22	1.01	5%
Russian Federation	RU	140	0.98	140	0.98	0%
San Marino	SM	1	31.11	1	30.82	–1%
Serbia	RS	17	2.34	18	2.49	6.4%
Slovakia	SK	13	2.37	14	2.55	8%
Slovenia	SI	6	3.01	8	4.01	34%
Spain	ES	220	4.68	230	4.86	3.8%
Sweden	SE	43	4.72	42	4.35	–8%

Continued

Table 6 Continued

Country	ISO code	Number of PM implanting centres 2012		Number of PM implanting centres 2013		Change %
		Absolute number	Per mil inhabitants	Absolute number	Per mil inhabitants	
Switzerland	CH	74	9.34	76	9.50	2%
Syria ^a	SY	N/A	N/A	N/A	N/A	N/A
Tunisia ^a	TN	10	1	N/A	N/A	N/A
Turkey ^a	TR	N/A	N/A	N/A	N/A	N/A
Ukraine	UA	36	0.79	36	0.81	2%
United Kingdom	GB	205	3.25	227	3.58	10%
Total ESC countries	56					

^aThese seven countries did not submit data for the EHRA White Book 2014.

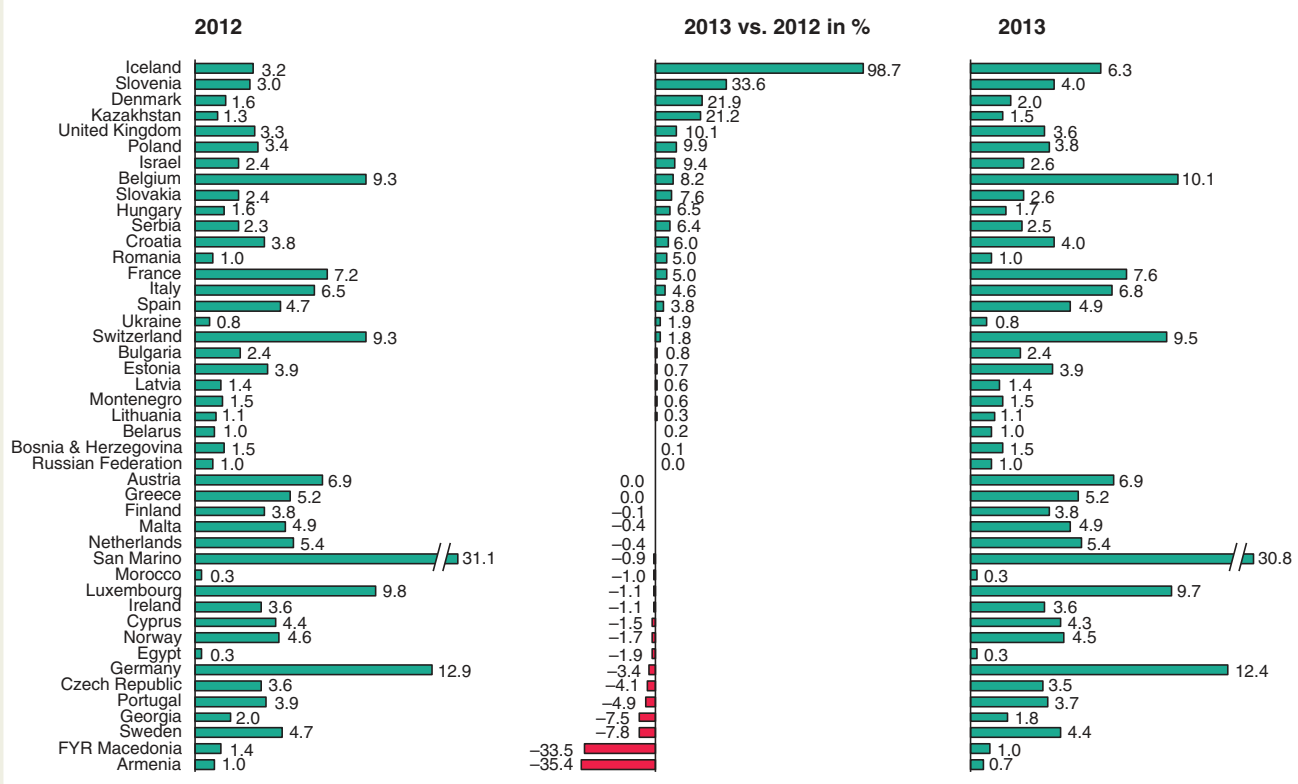


Figure 19 Change in the number of pacemaker implanting centres per million inhabitants 2012 to 2013.

standards for theoretical and practical training for all healthcare professionals, regardless of their country of origin.

Pacemakers

General information

The 49 countries (88% of all ESC member countries) that submitted the requested data on PM implantation for the EHRA White Book

are listed in Table 4. According to the EHRA White Book, 808 667 710 people lived in these countries. A national registry for PM implantations existed in 26 countries (Table 4). The vast majority of implants were performed by cardiologists (82%), and the remaining implantations were performed by physicians with various training backgrounds, including surgeons, anaesthesiologists, paediatricians, and internists. In some countries (Austria, Belarus, Bosnia and Herzegovina, Montenegro, Russian Federation, Slovenia, and Ukraine), the proportion of implanting cardiologists was 50% or less (Table 5).

Table 7 Changes in pacemaker implantations in year 2012 vs. 2013

Country	ISO code	PM implantations 2012		PM implantations 2013		Change %
		Absolute number	Per mil inhabitants	Absolute number	Per mil inhabitants	
Albania ^a	AL	N/A	N/A	N/A	N/A	N/A
Algeria	DZ	N/A	N/A	2480	65.11	N/A
Armenia	AM	221	74.40	94	30.68	– 59%
Austria	AT	7870	957.45	7950	966.96	1%
Azerbaijan	AZ	N/A	N/A	131	13.66	N/A
Belarus	BY	2651	274.90	2813	292.23	6.3%
Belgium	BE	12 817	1156.48	12 725	1218.37	5.4%
Bosnia & Herzegovina	BA	909	234.32	868	223.96	– 4.4%
Bulgaria	BG	3153	448.00	3511	502.89	12%
Croatia	HR	2515	561.38	2418	540.26	– 4%
Cyprus	CY	240	210.88	250	216.37	3%
Czech Republic	CZ	9150	899.06	9416	887.48	– 1.3%
Denmark	DK	4663	841.17	4725	850.36	1%
Egypt	EG	2500	29.87	2850	33.41	11.9%
Estonia	EE	954	748.41	1155	912.05	22%
Finland	FI	5208	990	5369	1019.54	3%
France	FR	62 846	957.57	60 000	909.76	– 5%
Georgia	GE	467	102.17	620	125.45	23%
Germany	DE	106 567	1310.69	93 520	1152.47	– 12%
Greece	GR	7440	690.95	7800	724.03	4.8%
Hungary	HU	6046	607.12	6143	618.04	1.8%
Iceland	IS	303	967.49	314	995.94	3%
Ireland	IE	2129	450.87	2288	479.06	6%
Israel	IL	4236	558.05	3966	514.59	– 8%
Italy	IT	61 300	1000.63	62 198	1011.64	1.1%
Kazakhstan	KZ	1227	70.03	1489	83.95	20%
Kosovo ^a	XK	N/A	N/A	N/A	N/A	N/A
Kyrgyzstan ^a	KGZ	N/A	N/A	N/A	N/A	N/A
Latvia	LV	1201	548.01	1288	591.25	7.9%
Lebanon	LB	N/A	N/A	900	217.83	N/A
Libya ^a	LY	N/A	N/A	N/A	N/A	N/A
Lithuania	LT	2666	756.15	2716	772.50	2.2%
Luxembourg	LU	316	620.73	188	365.15	– 41.2%
FYR Macedonia	MK	345	165.68	322	154.28	– 6.9%
Malta	MT	264	644.16	227	551.94	– 14.3%
Moldova	MD	N/A	N/A	287	79.28	N/A
Montenegro	ME	143	217.53	204	312.18	43.5%
Morocco	MA	1231	38.10	1109	33.97	– 10.8%
Netherlands	NL	9370	560.05	10 174	605.41	8.1%
Norway	NO	3456	691.20	3459	680.16	– 1.6%
Poland	PL	27 498	715.81	27 500	716.45	0.1%
Portugal	PT	8890	825	8790	813.94	– 1.3%
Romania	RO	3150	144.17	2400	110.14	– 24%
Russian Federation	RU	30 218	212.03	34 758	243.91	15%
San Marino	SM	26	808.96	14	431.46	– 47%

Continued

Table 7 Continued

Country	ISO code	PM implantations 2012		PM implantations 2013		Change %
		Absolute number	Per mil inhabitants	Absolute number	Per mil inhabitants	
Serbia	RS	3139	431.38	3958	546.46	26.7%
Slovakia	SK	3111	567.38	3456	629.70	11%
Slovenia	SI	1333	667.63	1287	645.86	-3%
Spain	ES	34 710	737.84	35 500	749.41	1.6%
Sweden	SE	9476	1040.89	9602	995.30	-4%
Switzerland	CH	5965	752.63	6097	762.50	1%
Syria ^a	SY	N/A	N/A	N/A	N/A	N/A
Tunisia ^a	TN	2500	233	N/A	N/A	N/A
Turkey ^a	TR	N/A	N/A	N/A	N/A	N/A
Ukraine	UA	5491	120.90	6579	147.60	22%
United Kingdom	GB	38 770	614.94	44 503	701.99	14%

^aThese seven countries did not submit data on PM implantations for the EHRA White Book 2014.

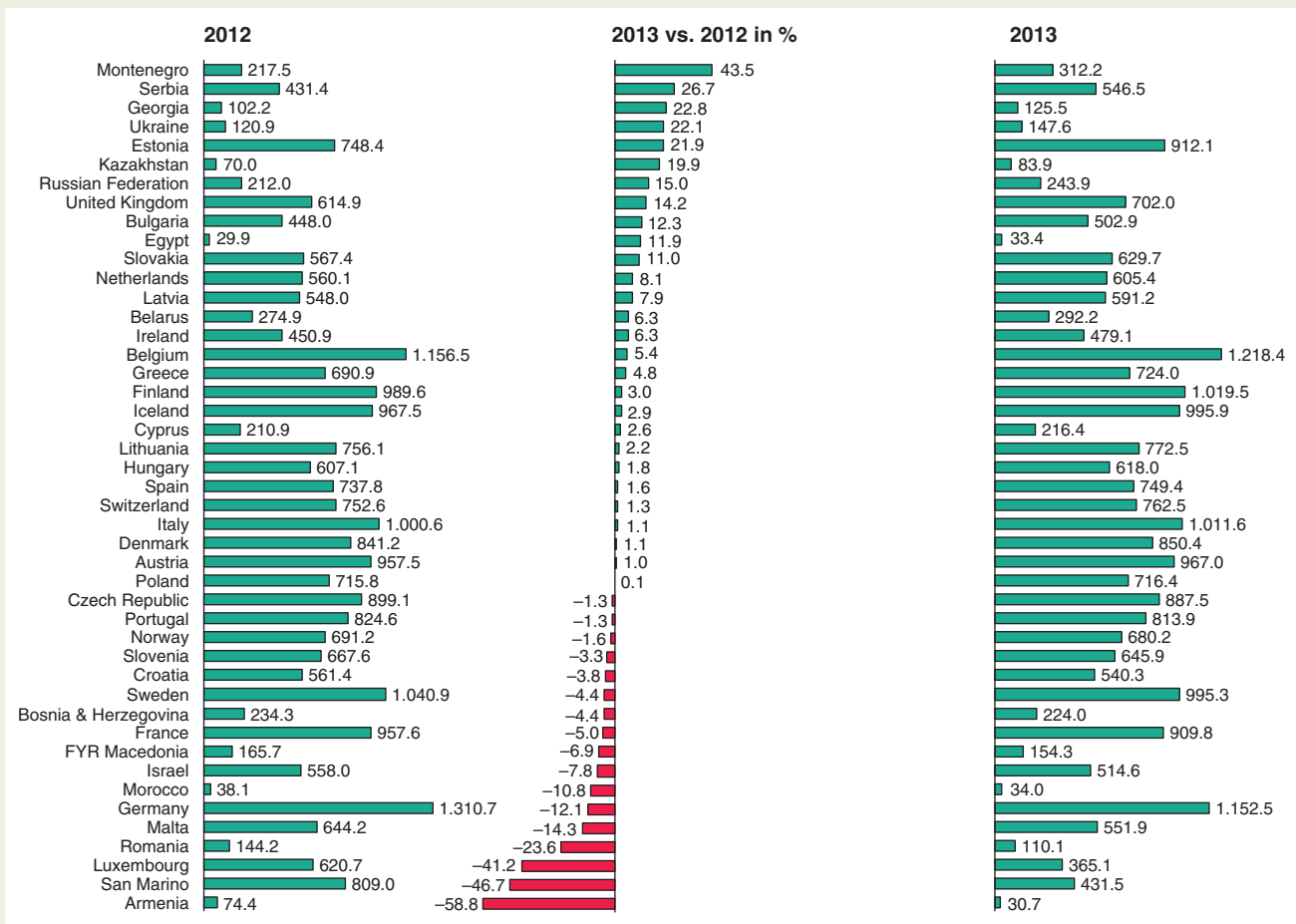


Figure 20 Change in the number of pacemaker implantations per million inhabitants 2012 to 2013.

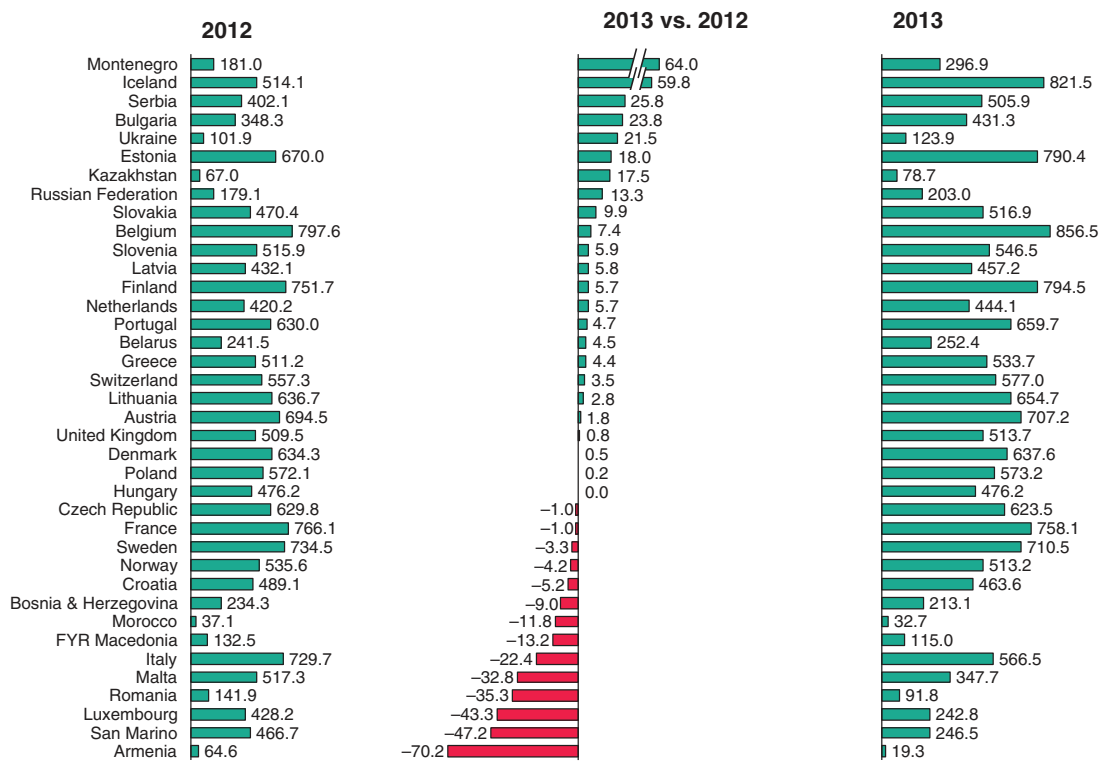


Figure 21 Change in the number of new pacemaker implantations per million inhabitants 2012 to 2013.

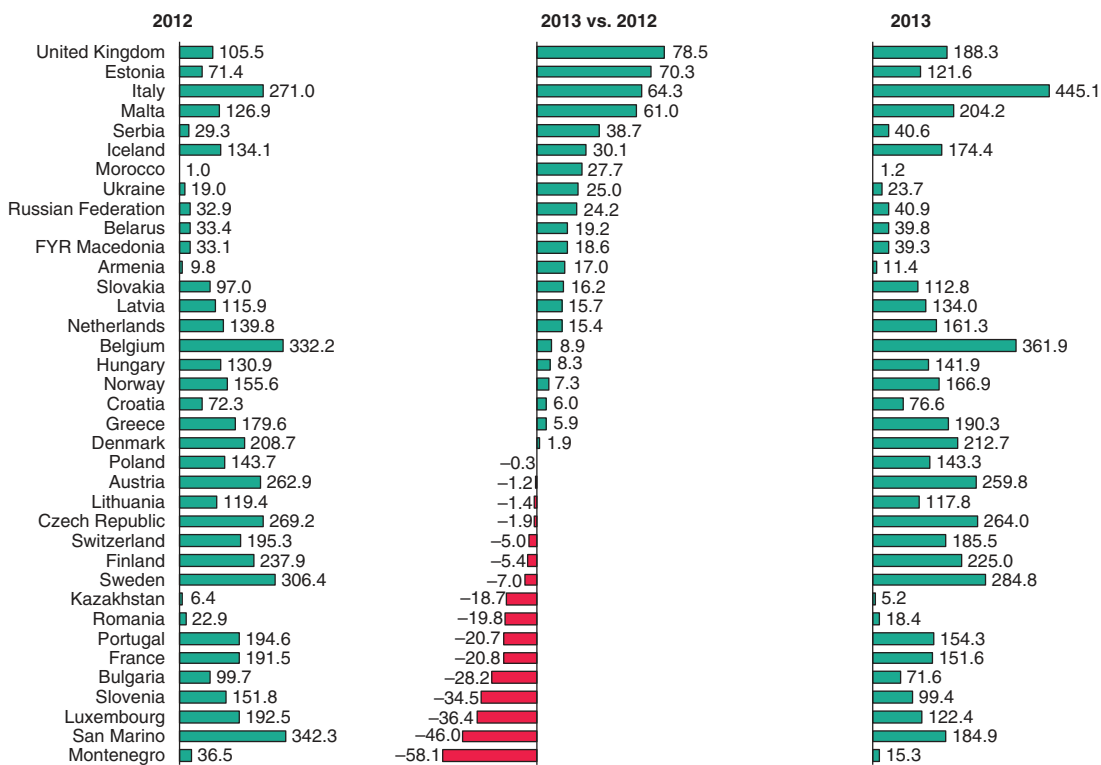


Figure 22 Change in the number of pacemaker replacements per million inhabitants 2012 to 2013.

Pacemaker facilities and procedure rate

It was reported that in 3580 centres, a total of 500 411 PMs were implanted in 2013 (Table 4). The mean number of centres implanting PMs per million inhabitants was (3.8) same as in the preceding year (Figure 10). Excluding San Marino, the country with the highest density of implanting facilities was Germany (12.4 per million in habitants) and those with the lowest density were Egypt, Moldova, and Morocco with only 0.3 implantations per million inhabitants (Figure 10) (0.3), which is consistent with EHRA White Book data from previous years.

In 2013, the mean PM implantation rate in the participating ESC countries was 532 PM units per million inhabitants. The implantation rate was highest in Belgium (1218) and Germany (1152), and lowest in Azerbaijan (14) and Egypt (30). An overview of the PM implantation rate per million inhabitants for each nation that reported to the EHRA White Book is shown in Figures 11 and 12. Across the 49 countries, marked heterogeneity was observed in the geographic distribution of PM implantation rate per million inhabitants.

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 (EU-28) 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, 15, 16, 17 and 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 (1.020), Italy (1.012), Czech Republic (887), and Israel (515). The PM implantation rate in Israel (515) was more than double compared with the second most active non-European ESC country.

The change in the number of implanting centres from 2102 to 2103 is shown 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 the Southern European countries Montenegro (44%) and Serbia (27%). Increase in PM implantation exceeded 20% also in Georgia, Ukraine, and Estonia. On the other hand, there was a >20% drop in the number of devices implanted in Armenia (59%), San Marino (47%), Luxembourg (41%), and Romania (24%). The changes in the *de novo* implantation rate are shown 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 28 member countries of the European Union (EU28) is shown in Figure 23.

Implantable cardioverter defibrillators

General information

The 46 countries which submitted data for the EHRA White Book on ICDs in 2013 are listed in Table 8. Albania, Belarus, France, Kosovo, Kyrgyzstan, Libya, Portugal, Syria, Tunisia, and Turkey did not report data related to ICD implantations. In 28 countries, a national registry for ICD implantations was in use, surprisingly slightly down from 30 in 2012. France, a country with a moderately high implantation rate in previous years, did not provide data on the use of ICDs for 2013. The vast majority of implants were performed by cardiologists (83%), and the remaining implantations were performed by physicians having various other training backgrounds, mainly surgical.

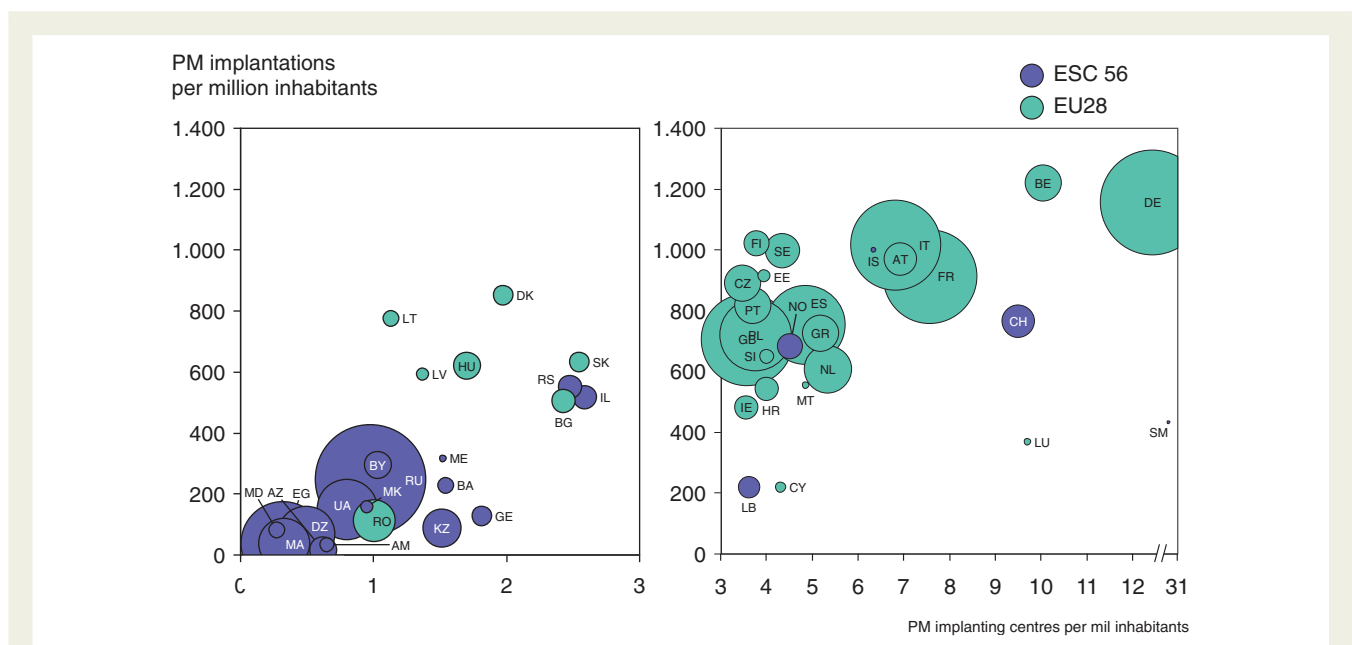


Figure 23 Pacemaker (PM) implantation centres and rates in the European Society of Cardiology (ESC) and European Union (EU28) member countries in 2013. Bubble size is related to population in the country.

Table 8 Implantable cardioverter defibrillator implantation facilities and rates in the ESC countries in 2013 and comparison to four previous years

Country	ISO code	National Registry for ICD implants	Number of ICD implanting centres 2013		ICD implantations 2013		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 EU-28 level	2009	2010	2011	2012	2013
Albania ^a	AL	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Algeria	DZ	No	8	0.21	38	1	3800	6839	N/A	N/A	N/A	N/A	1
Armenia	AM	No	2	0.65	28	9	306	550	10	11	12	N/A	9
Austria	AT	Yes	21	2.55	1296	158	–	1476	154	151	220	145	158
Azerbaijan	AZ	No	2	0.21	13	1	957	1722	N/A	2	2	N/A	1
Belarus ^a	BY	Yes	N/A	N/A	N/A	N/A	N/A	N/A	5	6	14	12	N/A
Belgium	BE	Yes	23	2.20	1704	163	–	1875	169	188	197	198	163
Bosnia & Herzegovina	BA	No	5	1.29	65	17	387	696	N/A	8	13	14	17
Bulgaria	BG	Yes	8	1.15	32	5	697	1254	1	1	8	7	5
Croatia	HR	N/A	12	2.68	156	35	447	804	24	18	19	26	35
Cyprus	CY	No	3	2.60	60	52	115	207	45	43	58	46	52
Czech Republic	CZ	Yes	17	1.60	3196	301	–	–	117	251	270	277	301
Denmark	DK	Yes	6	1.08	1285	231	–	–	181	194	198	218	231
Egypt	EG	No	13	0.15	178	2	8511	15 316	0	1	N/A	2	2
Estonia	EE	No	2	1.58	104	82	126	227	15	39	45	79	82
Finland	FI	No	19	3.61	1020	194	–	–	120	150	134	166	194
France ^a	FR	No	148	2.24	N/A	N/A	N/A	N/A	88	94	102	106	N/A
Georgia	GE	No	7	1.42	59	12	493	887	2	3	5	12	12
Germany	DE	No	654	8.06	27 241	336	–	–	288	305	326	326	336
Greece	GR	No	24	2.23	1050	97	1075	1934	102	86	83	87	97
Hungary	HU	Yes	14	1.41	940	95	992	1785	61	72	80	85	95
Iceland	IS	No	1	3.17	54	171	–	57	88	78	113	134	171
Ireland	IE	Yes	17	3.56	732	153	–	858	144	134	140	144	153
Israel	IL	Yes	20	2.60	1277	166	–	1384	109	178	156	137	166
Italy	IT	Yes	365	5.94	12 556	204	–	–	174	183	196	196	204
Kazakhstan	KZ	No	12	0.68	221	12	1770	3185	N/A	N/A	N/A	7	12
Kosovo ^a	XK	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Kyrgyzstan ^a	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
Latvia	LV	Yes	2	0.92	88	40	217	391	16	19	29	32	40
Lebanon	LB	No	10	2.42	300	73	412	742	N/A	N/A	N/A	N/A	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	0.85	124	35	351	631	19	26	33	42	35

Continued

Table 8 Continued

Country	ISO code	National Registry for ICD implants	Number of ICD implanting centres 2013		ICD implantations 2013		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 EU-28 level	2009	2010	2011	2012	2013
Luxembourg	LU	Yes	1	1.94	71	138	—	92	86	73	99	149	138
FYR Macedonia	MK	Yes	2	0.96	12	6	208	375	2	7	13	7	6
Malta	MT	Yes	1	2.43	67	163	—	74	82	72	71	132	163
Moldova	MD	N/A	0	0.00	0	0	361	650	N/A	N/A	N/A	N/A	0
Montenegro	ME	No	1	1.53	38	58	65	117	29	29	47	44	58
Morocco	MA	Yes	5	0.15	34	1	3258	5863	N/A	1	1	1	1
Netherlands	NL	Yes	31	1.84	4096	244	—	—	N/A	171	155	160	244
Norway	NO	Yes	11	2.16	1089	214	—	—	110	125	184	199	214
Poland	PL	No	115	3.00	9500	248	—	—	138	183	157	182	248
Portugal ^a	PT	Yes	27	2.50	N/A	N/A	N/A	N/A	69	75	95	92	N/A
Romania	RO	Yes	17	0.78	200	9	2174	3913	6	8	8	8	9
Russian Federation	RU	Yes	57	0.40	1870	13	14 219	25 588	4	4	10	11	13
San Marino	SM	Yes	1	30.82	20	616	—	—	656	625	597	404	616
Serbia	RS	Yes	8	1.10	448	62	723	1301	52	39	44	38	62
Slovakia	SK	Yes	4	0.73	591	108	—	985	82	91	100	105	108
Slovenia	SI	Yes	2	1.00	142	71	199	358	54	50	72	61	71
Spain	ES	Yes	153	3.23	3885	82	4727	8506	84	71	74	73	82
Sweden	SE	Yes	29	3.01	1911	198	—	—	71	114	N/A	193	198
Switzerland	CH	Yes	46	5.75	1604	201	—	—	176	203	142	195	201
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 ^a	TN	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5	8	8	9	N/A
Turkey ^a	TR	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Ukraine	UA	No	17	0.38	85	2	4447	8004	0	1	1	1	2
United Kingdom	GB	Yes	106	1.67	5809	92	6326	11 383	82	83	86	91	92
Total	56		2052		85 289								

^aThese 10 countries did not submit data on ICD implantations in 2013 for the EHRA White Book.

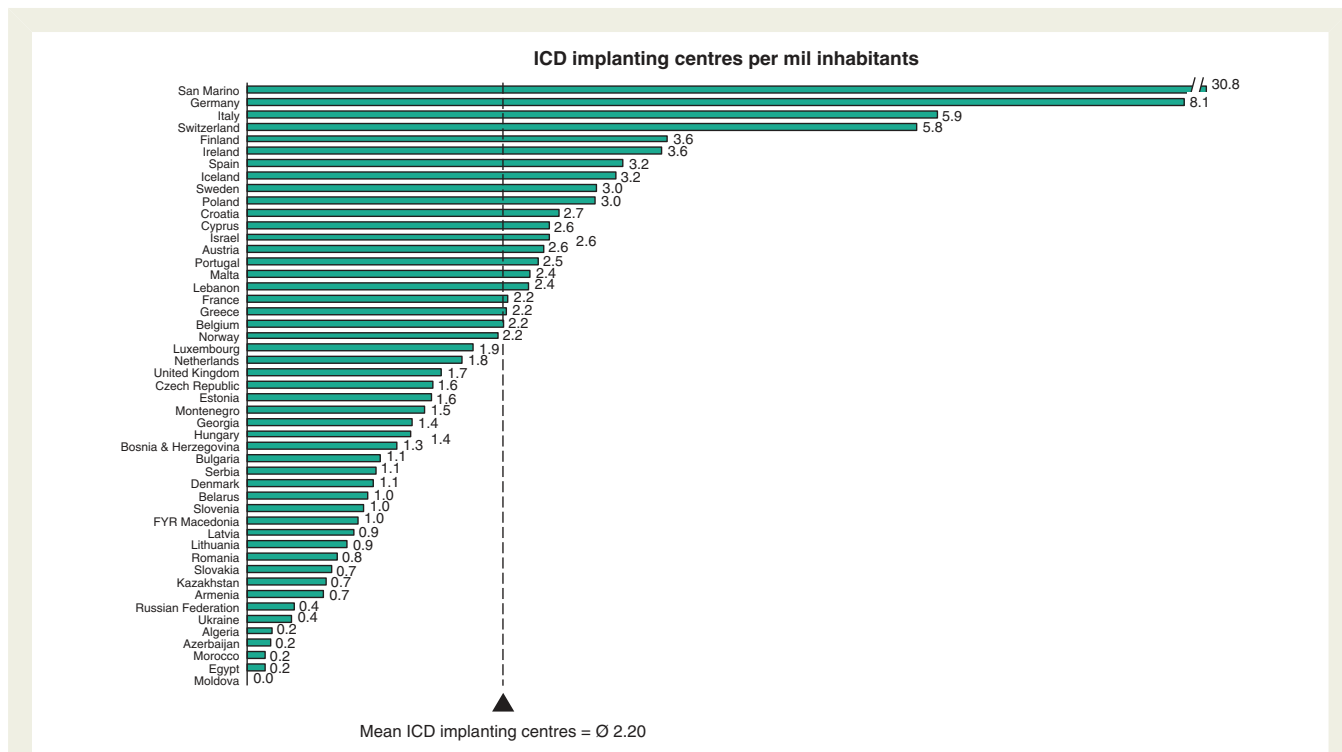


Figure 24 Implantable cardioverter defibrillator (ICD) implanting centres per million inhabitants in 2013. Mean number of implantation centres is weighted by population.

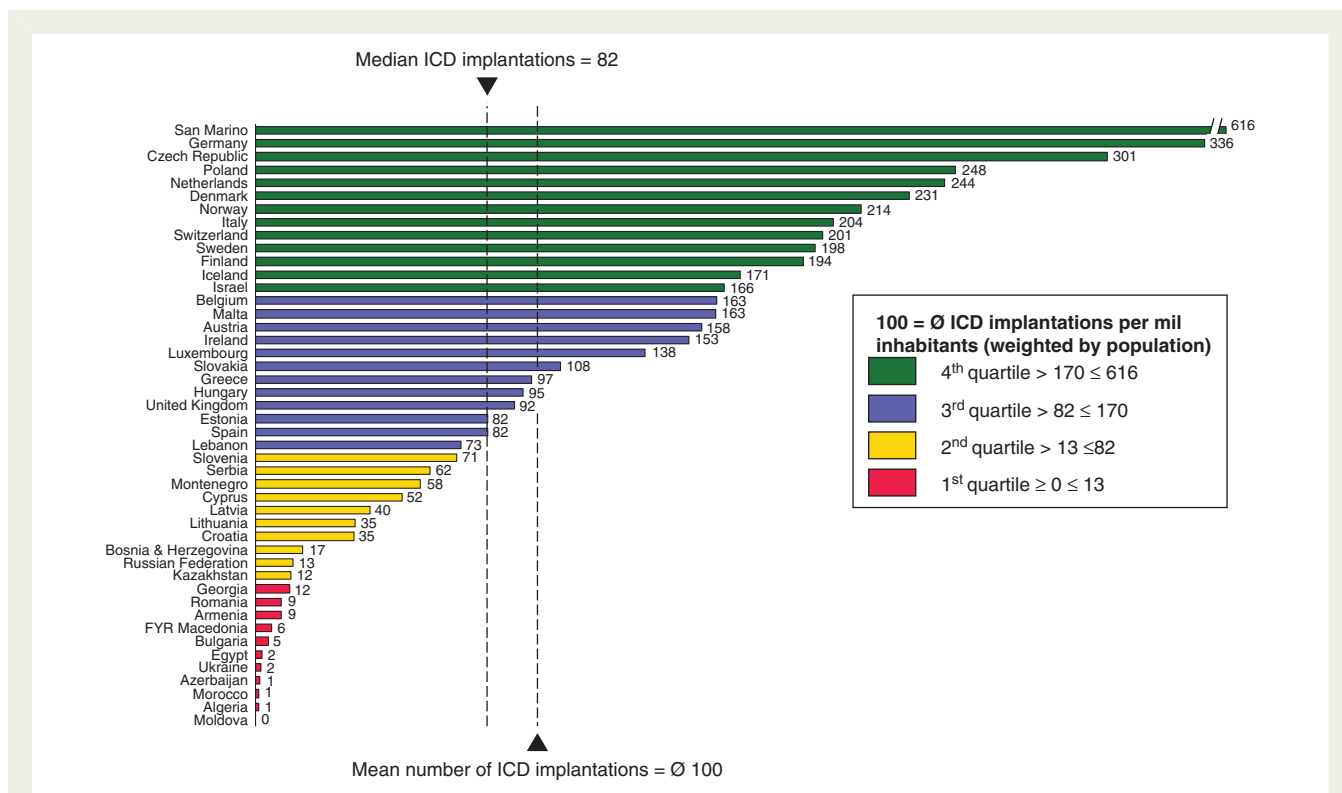


Figure 25 Implantable cardioverter defibrillator (ICD) implantations per million inhabitants in 2013.

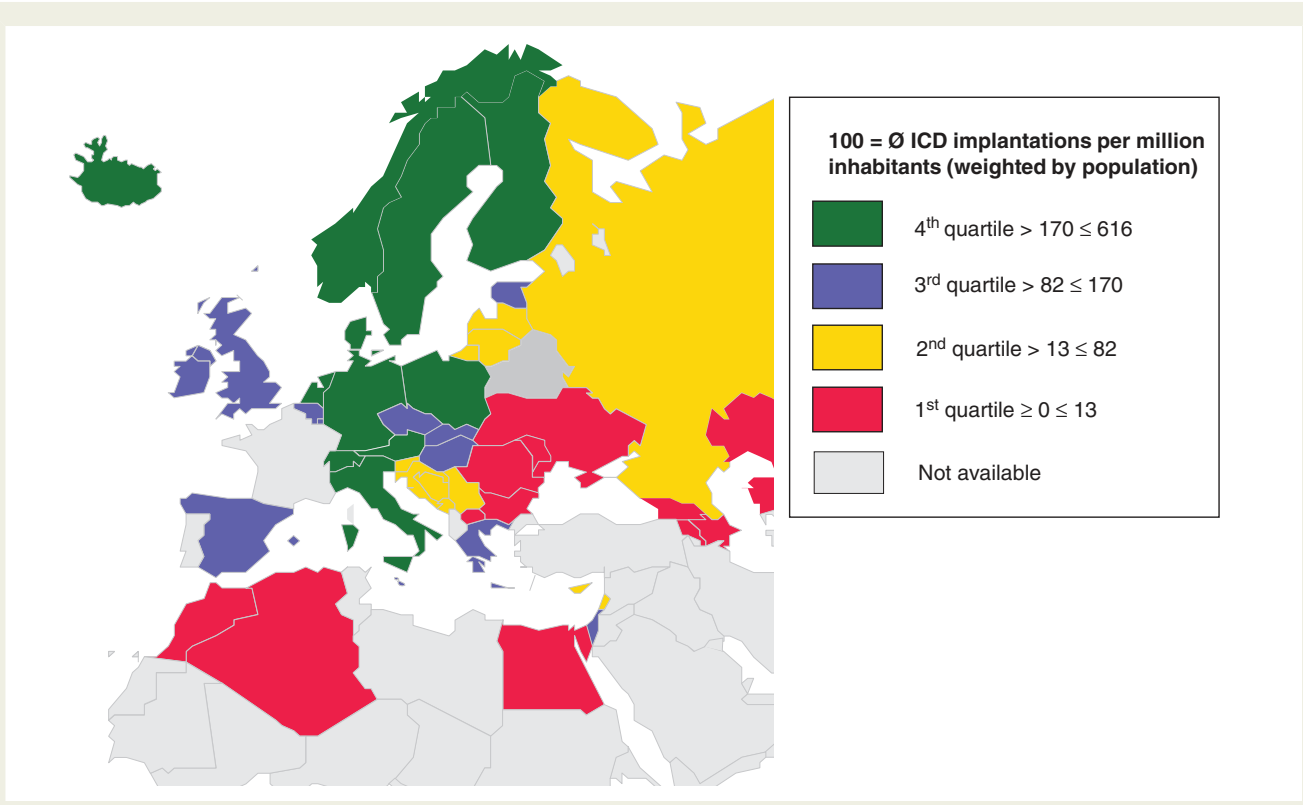


Figure 26 Implantable cardioverter defibrillator (ICD) implantations in the European Society of Cardiology countries in 2013.

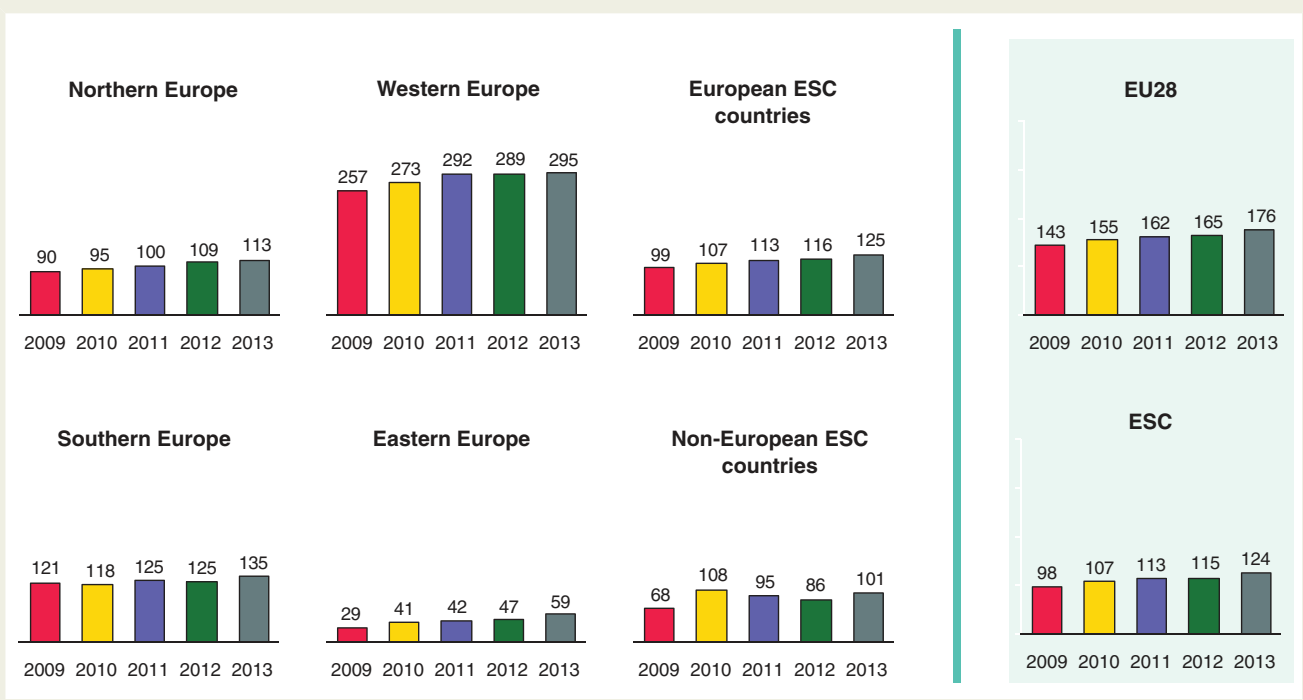


Figure 27 Implantable cardioverter defibrillator (ICD) implantations per million inhabitants 2009–2013 in the five geographical regions of the European Society of Cardiology (ESC) and comparison to the total ESC area and the 28 member countries of the European Union (EU28).

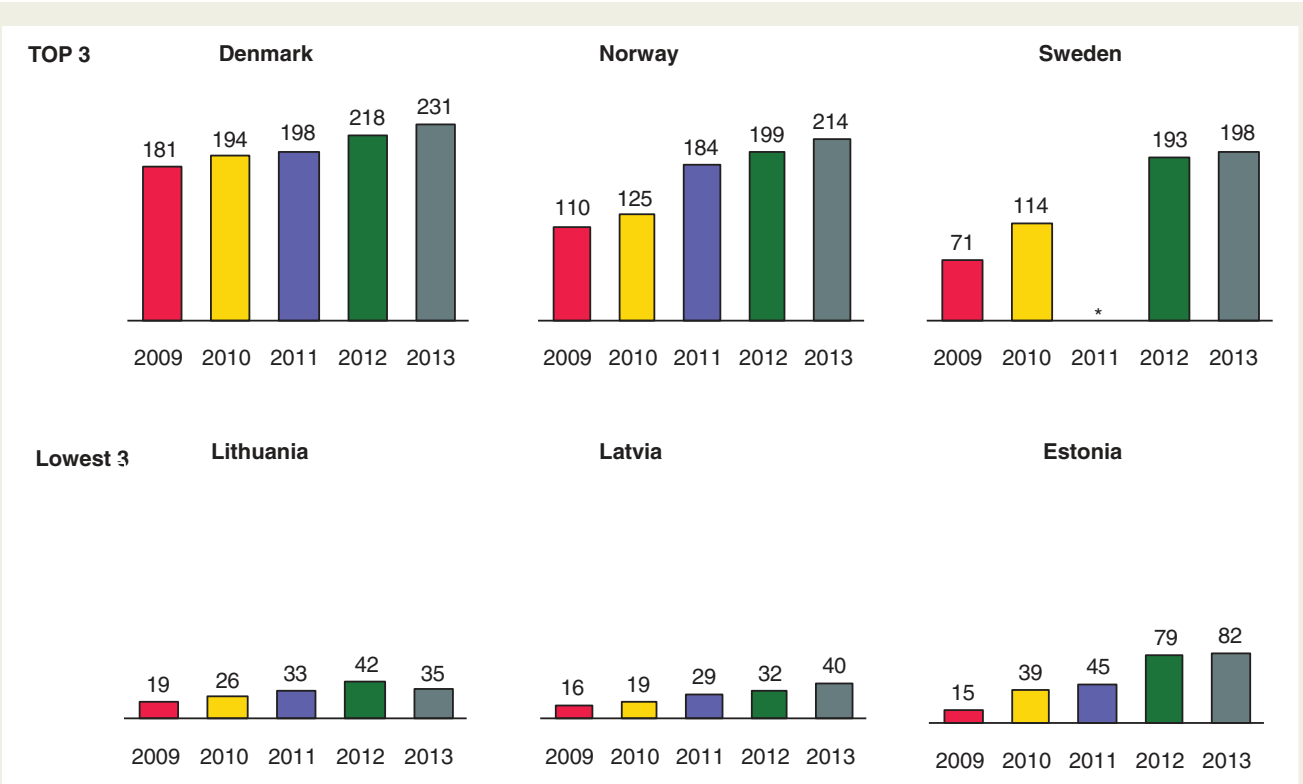


Figure 28 Implantable cardioverter defibrillator (ICD) implantations per million inhabitants 2009–2013 in Northern Europe. *No data available.

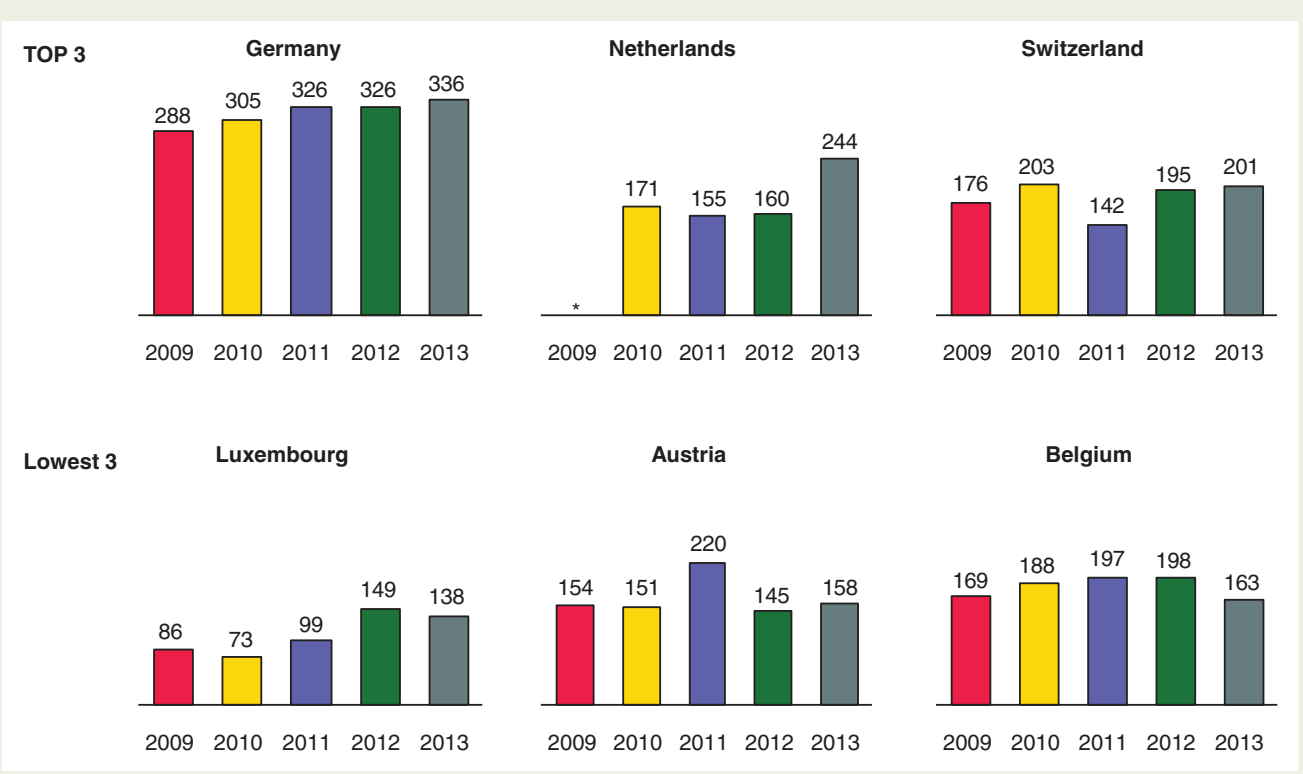


Figure 29 Implantable cardioverter defibrillator (ICD) implantations per million inhabitants 2009–2013 in Western Europe. *No data available.

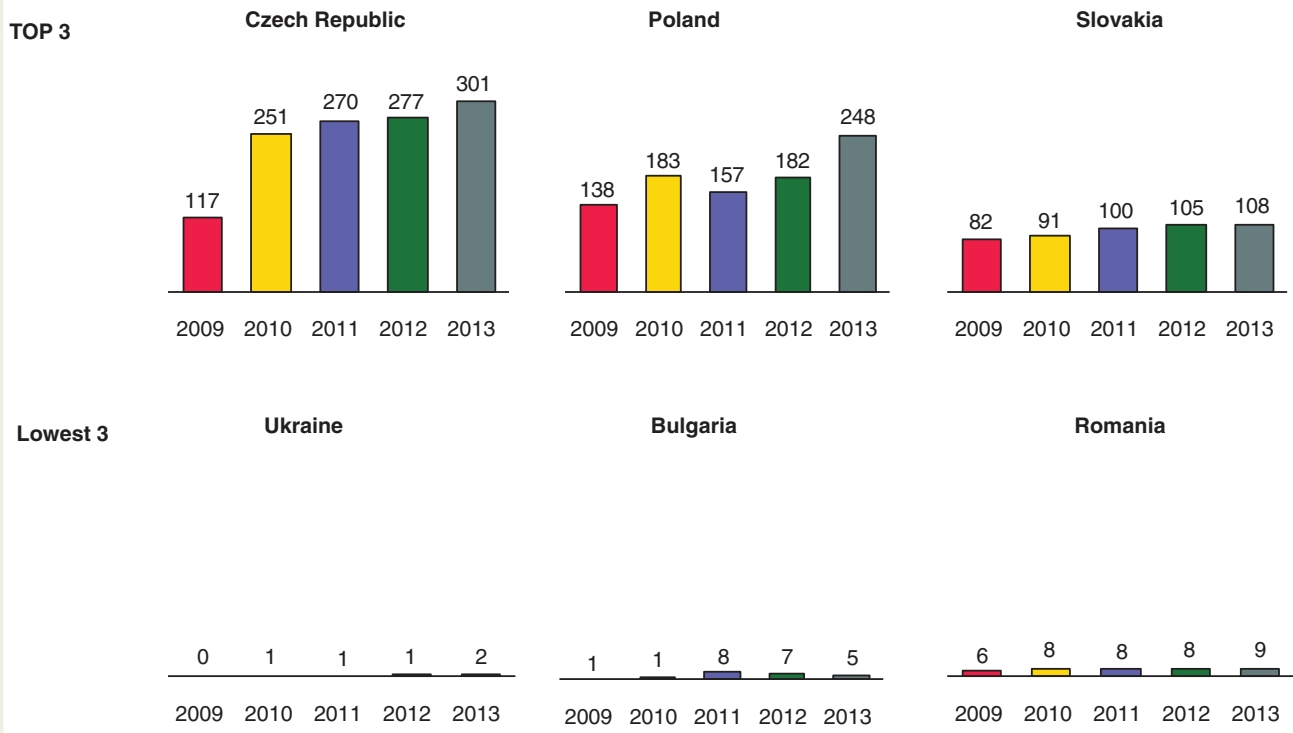


Figure 30 Implantable cardioverter defibrillator (ICD) implantations per million inhabitants 2009–2013 in Eastern Europe.

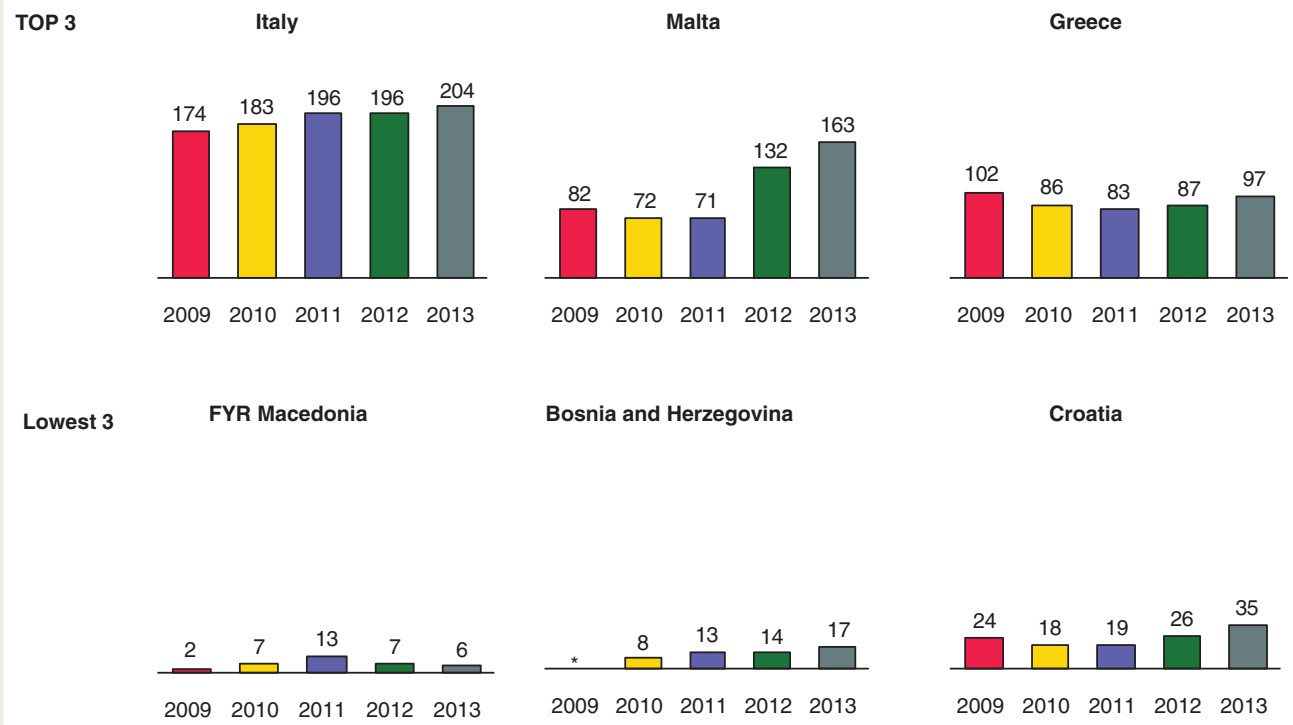


Figure 31 Implantable cardioverter defibrillator (ICD) implantations per million inhabitants 2009–2013 in Southern Europe. *No data available.

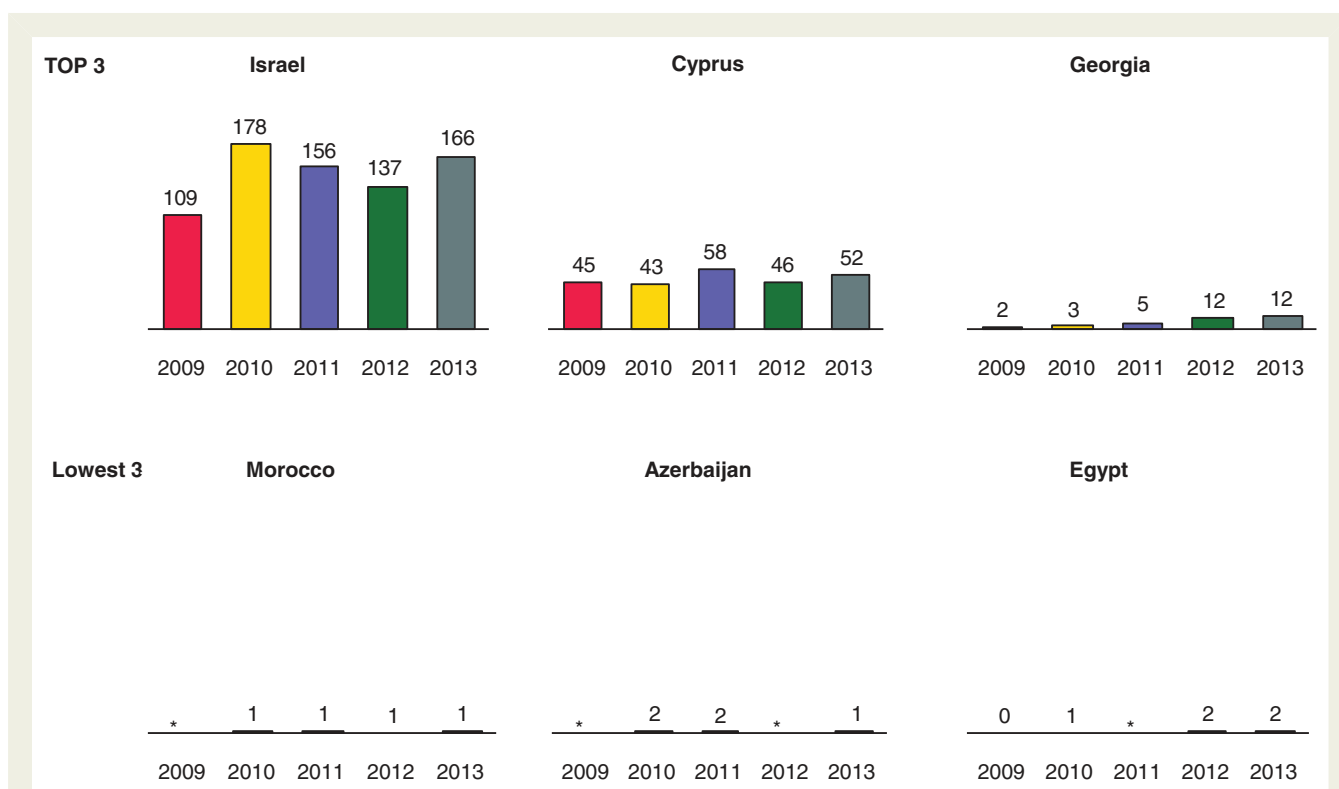


Figure 32 Implantable cardioverter defibrillator (ICD) implantations per million inhabitants 2009–2013 in non-European European Society of Cardiology (ESC) countries. *No data available.

However, in some countries (Austria, Iceland, Kazakhstan, Montenegro, Russian Federation, Slovenia, and Ukraine), the proportion of implanting cardiologists was about 50% or less (Table 5).

Implantable cardioverter defibrillator facilities and procedure rates

It was reported that in 2052 national centres, a total of 85 289 ICDs were implanted in 2013 (Table 8). Table 8 also shows a comparison to previous years in each country. The number of ICD implantation centres per million inhabitants is shown in Figure 24. In the ESC area the mean number of ICD implantations per million inhabitants in 2013 was 100 compared with 96 in 2012. In Figures 25 and 26 the ESC countries are grouped into quartiles according to the number of ICD implantations per million inhabitants. Excluding San Marino, Germany (336 per million inhabitants), the Czech Republic (301), and Belarus (292) had the highest implant rates while the lowest reported were in Algeria, Azerbaijan, and Morocco (1 per million inhabitants for each). In Moldova no ICDs were implanted in 2013 (Table 8 and Figure 25).

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, is shown in Figure 27. In Western Europe the number of ICD implantations per million inhabitants (295) was more than twice higher than in any other ESC region. Implantable cardioverter defibrillator implantation rate exceed 100 per million

population also in the Southern (135) and Northern (113) European regions and in the non-European ESC countries (101), whereas in the Eastern European region only 59 ICDs per million population were implanted. The top and bottom three countries within the five ESC region are shown in Figures 28, 29, 30, 31 and 32. After excluding San Marino, the most active countries in each region were Germany (336 per million inhabitants), Denmark (231), the Czech Republic (301), Italy (204), and Israel (166). The mean number of implanting centres in ESC area was 2.2 per country.

The change in the number of implanting centres from 2102 to 2103 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, Ukraine, and Serbia. Given the above reported disparities in ICD use in Europe, it was encouraging that ICD implantation rate increased by >25% in the Eastern European area. On the other hand, four countries (Bulgaria, FYR Macedonia, Belgium, and Lithuania) reported a >10% 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 are shown in Figure 37.

Table 9 Change in the number of ICD implantation centres in year 2012 vs. 2013

Country	ISO code	Number of ICD implanting centres 2012		Number of ICD implanting centres 2013		Change %
		Absolute number	Per mil inhabitants	Absolute number	Per mil inhabitants	
Albania ^a	AL	N/A	N/A	N/A	N/A	N/A
Algeria	DZ	N/A	N/A	8	0.21	N/A
Armenia	AM	3	1.01	2	0.65	-35%
Austria	AT	21	2.55	21	2.55	0%
Azerbaijan	AZ	N/A	N/A	2	0.21	N/A
Belarus	BY	7	0.73	N/A	N/A	N/A
Belgium	BE	23	2.08	23	2.20	6.1%
Bosnia & Herzegovina	BA	4	1.03	5	1.29	25.1%
Bulgaria	BG	4	0.57	8	1.15	102%
Croatia	HR	12	2.68	12	2.68	0%
Cyprus	CY	3	2.64	3	2.60	-2%
Czech Republic	CZ	17	1.67	17	1.60	-4.1%
Denmark	DK	6	1.08	6	1.08	0%
Egypt	EG	11	0.13	13	0.15	16.0%
Estonia	EE	2	1.57	2	1.58	1%
Finland	FI	19	3.61	19	3.61	0%
France	FR	148	2.26	148	2.24	0%
Georgia	GE	7	1.53	7	1.42	-8%
Germany	DE	670	8.24	654	8.06	-2%
Greece	GR	24	2.23	24	2.23	0.0%
Hungary	HU	13	1.31	14	1.41	7.9%
Iceland	IS	1	3.19	1	3.17	-1%
Ireland	IE	17	3.60	17	3.56	-1%
Israel	IL	21	2.77	20	2.60	-6%
Italy	IT	360	5.88	365	5.94	1.0%
Kazakhstan	KZ	5	0.29	12	0.68	137%
Kosovo ^a	XK	N/A	N/A	N/A	N/A	N/A
Kyrgyzstan ^a	KGZ		0	N/A	N/A	N/A
Latvia	LV	2	0.91	2	0.92	0.6%
Lebanon	LB	N/A	N/A	10	2.42	N/A
Libya ^a	LY	N/A	N/A	N/A	N/A	N/A
Lithuania	LT	3	0.85	3	0.85	0.3%
Luxembourg	LU	1	1.96	1	1.94	-1.1%
FYR Macedonia	MK	2	0.96	2	0.96	-0.2%
Malta	MT	1	2.44	1	2.43	-0.4%
Moldova	MD	N/A	N/A	0	0.00	N/A
Montenegro	ME	1	1.52	1	1.53	0.6%
Morocco	MA	7	0.22	5	0.15	-29.3%
Netherlands	NL	28	1.67	31	1.84	10.2%
Norway	NO	11	2.20	11	2.16	-1.7%
Poland	PL	111	2.89	115	3.00	3.7%
Portugal	PT	24	2	27	2.50	12.3%
Romania	RO	17	0.78	17	0.78	0%
Russian Federation	RU	57	0.40	57	0.40	0%
San Marino	SM	1	31.11	1	30.82	-1%
Serbia	RS	10	1.37	8	1.10	-19.6%
Slovakia	SK	4	0.73	4	0.73	0%
Slovenia	SI	3	1.50	2	1.00	-33%
Spain	ES	161	3.42	153	3.23	-5.6%
Sweden	SE	35	3.84	29	3.01	-22%

Continued

Table 9 Continued

Country	ISO code	Number of ICD implanting centres 2012		Number of ICD implanting centres 2013		Change %
		Absolute number	Per mil inhabitants	Absolute number	Per mil inhabitants	
Switzerland	CH	41	5.17	46	5.75	11%
Syria ^a	SY	N/A	N/A	N/A	N/A	N/A
Tunisia ^a	TN	N/A	N/A	N/A	N/A	N/A
Turkey ^a	TR	N/A	N/A	N/A	N/A	N/A
Ukraine	UA	9	0.20	17	0.38	92%
United Kingdom	GB	114	1.81	106	1.67	–8%

^aThese seven countries did not submit on ICD implantation centres in 2013 for the EHRA White Book.

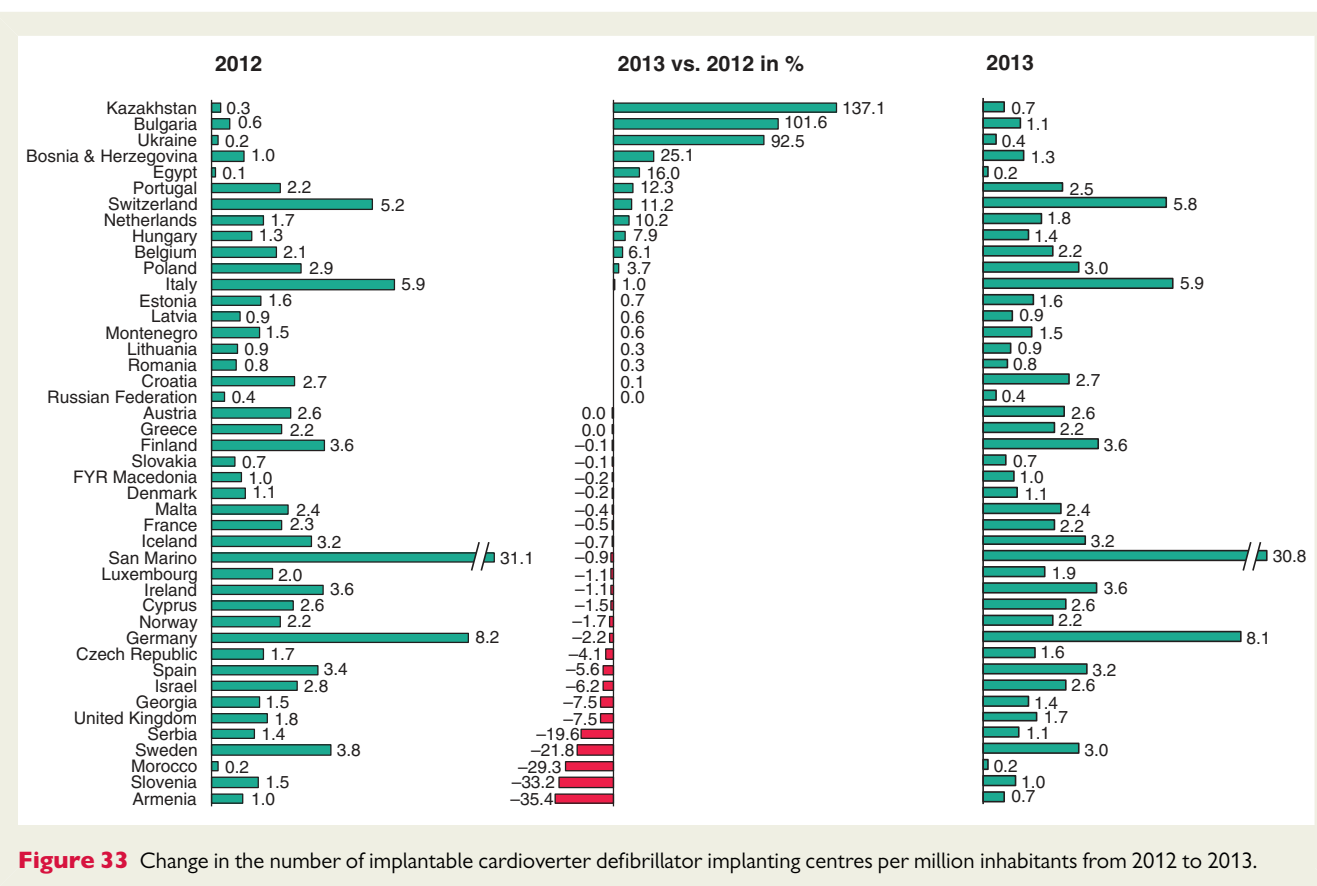


Figure 33 Change in the number of implantable cardioverter defibrillator implanting centres per million inhabitants from 2012 to 2013.

Cardiac resynchronization therapy devices

General information

The 46 countries that submitted data on CRT for the EHRA White Book 2014 are listed in Table 11. Albania, Belarus, Cyprus, France, Kosovo, Kyrgyzstan, Libya, Syria, Tunisia, and Turkey did not report data related to CRT therapy. France has previously reported a high rate of CRT implantations and its absence therefore significantly affects the combined data. Germany and Portugal reported the data for CRT defibrillators (CRT-D) only. The vast majority of

implants were performed by cardiologists (Table 5), and the remaining implantations were performed by physicians having various other training backgrounds, mainly surgeons. However, in some countries (Austria, Belarus, Germany, Iceland, Kazakhstan, Russian Federation, and Ukraine), the proportion of implanting cardiologists was about 50% or less (Table 5).

Cardiac resynchronization therapy facilities and procedure rates

It was reported that in 2013, a total of 51 274 CRT devices were implanted in 1701 national centres. There was a decrease in both

Table 10 Change in the number of ICD implantations in year 2013 vs. 2012

Country	ISO code	ICD implantations 2012		ICD implantations 2013		Change %
		Absolute number	Per mil inhabitants	Absolute number	Per mil inhabitants	
Albania ^a	AL	N/A	N/A	N/A	N/A	N/A
Algeria	DZ	N/A	N/A	38	1.00	N/A
Armenia	AM	N/A	N/A	28	9.14	N/A
Austria	AT	1195	145.38	1296	157.63	8%
Azerbaijan	AZ	N/A	N/A	13	1.36	N/A
Belarus ^a	BY	114	11.82	N/A	N/A	N/A
Belgium	BE	2197	198.24	1704	163.15	-17.7%
Bosnia & Herzegovina	BA	53	13.66	65	16.77	22.8%
Bulgaria	BG	47	6.68	32	4.58	-31%
Croatia	HR	118	26.34	156	34.86	32%
Cyprus	CY	52	45.69	60	51.93	14%
Czech Republic	CZ	2824	277.48	3196	301.23	8.6%
Denmark	DK	1207	217.73	1285	231.26	6%
Egypt	EG	151	1.80	178	2.09	15.7%
Estonia	EE	101	79.23	104	82.12	4%
Finland	FI	874	166	1020	193.69	17%
France ^a	FR	6986	106.44	N/A	N/A	N/A
Georgia	GE	53	11.60	59	11.94	3%
Germany	DE	26 536	326.37	27 241	335.70	3%
Greece	GR	938	87.11	1050	97.47	11.9%
Hungary	HU	844	84.75	940	94.57	11.6%
Iceland	IS	42	134.11	54	171.28	28%
Ireland	IE	682	144.43	732	153.27	6%
Israel	IL	1038	136.75	1277	165.69	21%
Italy	IT	12 000	195.88	12 556	204.22	4.3%
Kazakhstan	KZ	116	6.62	221	12.46	88%
Kosovo ^a	XK	N/A	N/A	N/A	N/A	N/A
Kyrgyzstan ^a	KGZ	N/A	N/A	N/A	N/A	N/A
Latvia	LV	70	31.94	88	40.40	26.5%
Lebanon	LB	N/A	N/A	300	72.61	N/A
Libya ^a	LY	N/A	N/A	N/A	N/A	N/A
Lithuania	LT	149	42.26	124	35.27	-16.5%
Luxembourg	LU	76	149.29	71	137.90	-7.6%
FYR Macedonia	MK	15	7.20	12	5.75	-20.2%
Malta	MT	54	131.76	67	162.91	23.6%
Moldova	MD	N/A	N/A	0	0.00	N/A
Montenegro	ME	29	44.11	38	58.15	31.8%
Morocco	MA	21	0.65	34	1.04	60.2%
Netherlands	NL	2669	159.53	4096	243.74	52.8%
Norway	NO	994	198.80	1089	214.13	7.7%
Poland	PL	7006	182.38	9500	247.50	35.7%
Portugal ^a	PT	990	92	N/A	N/A	N/A
Romania	RO	178	8.15	200	9.18	13%
Russian Federation	RU	1580	11.09	1870	13.12	18%
San Marino	SM	13	404.48	20	616.37	52%
Serbia	RS	277	38.07	448	61.85	62.5%
Slovakia	SK	577	105.23	591	107.68	2%

Continued

Table 10 Continued

Country	ISO code	ICD implantations 2012		ICD implantations 2013		Change %
		Absolute number	Per mil inhabitants	Absolute number	Per mil inhabitants	
Slovenia	SI	122	61.10	142	71.26	17%
Spain	ES	3434	73.00	3885	82.01	12.4%
Sweden	SE	1758	193.11	1911	198.08	3%
Switzerland	CH	1549	195.44	1604	200.60	3%
Syria ^a	SY	N/A	N/A	N/A	N/A	N/A
Tunisia ^a	TN	100	9	N/A	N/A	N/A
Turkey ^a	TR	N/A	N/A	N/A	N/A	N/A
Ukraine	UA	52	1.14	85	1.91	67%
United Kingdom	GB	5762	91.39	5809	91.63	0%
Total ESC countries	56					

^aThese 10 countries did not submit data on ICD implantations for the EHRA White Book 2014.

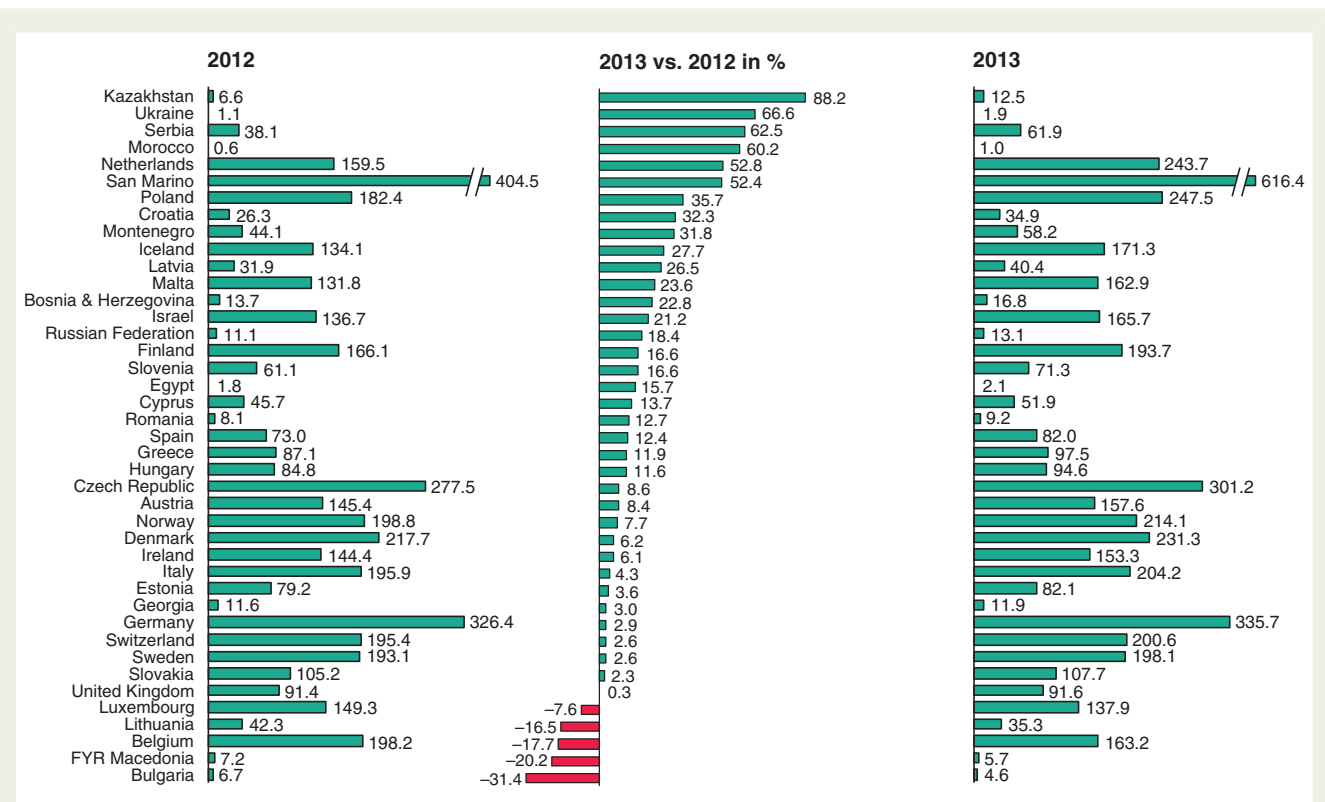


Figure 34 Change in the number of implantable cardioverter defibrillator implantations per million inhabitants from 2012 to 2013.

absolute numbers of implants and the rate of implants per million inhabitants compared with 2012, whereas a steady growth had been witnessed from 2009 (Table 11). The absence of French data in 2013 is an important 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 facilities was 183 per country, which is similar to that for 2012 (19). Italy and

Germany, both approaching six implanting facilities per million inhabitants, had the highest density of centres implanting CRT devices.

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-P) and defibrillators (CRT-D). The ratio of CRT-D/CRT-P implants was 2.6 with a mean of 44 CRT-Ds and 17

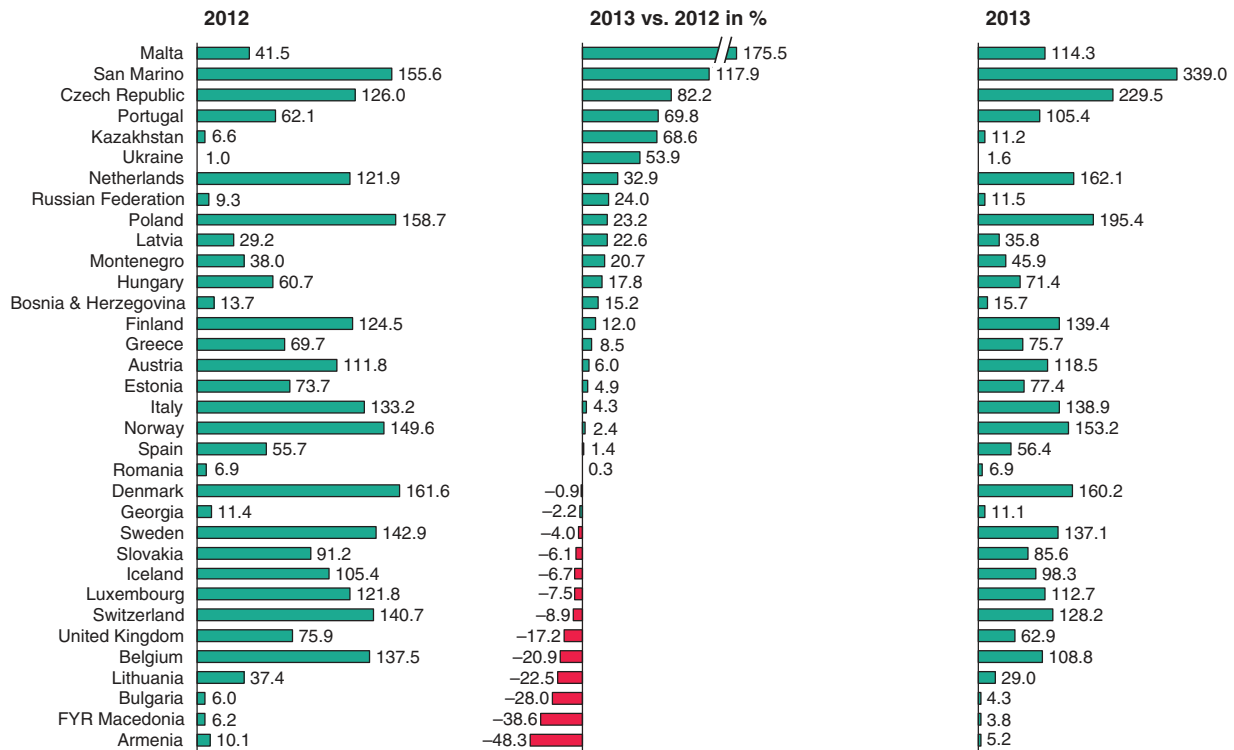


Figure 35 Change in the number of new implantable cardioverter defibrillator implantations per million inhabitants from 2012 to 2013.

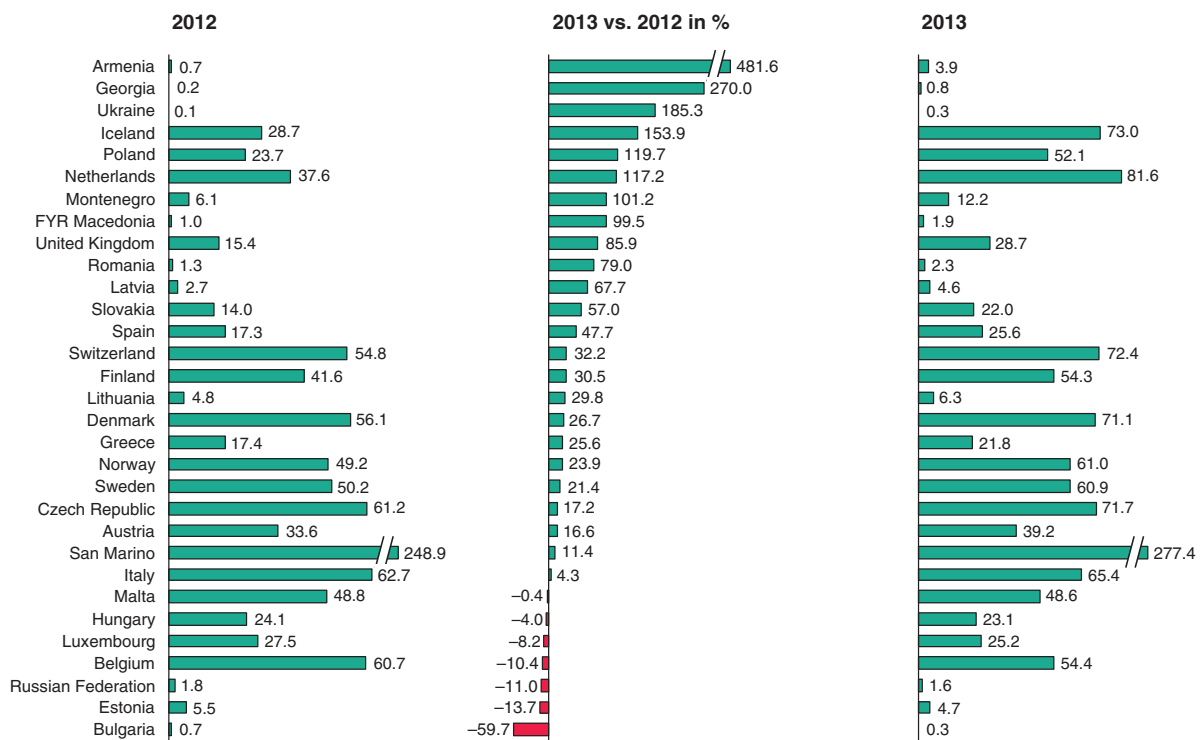
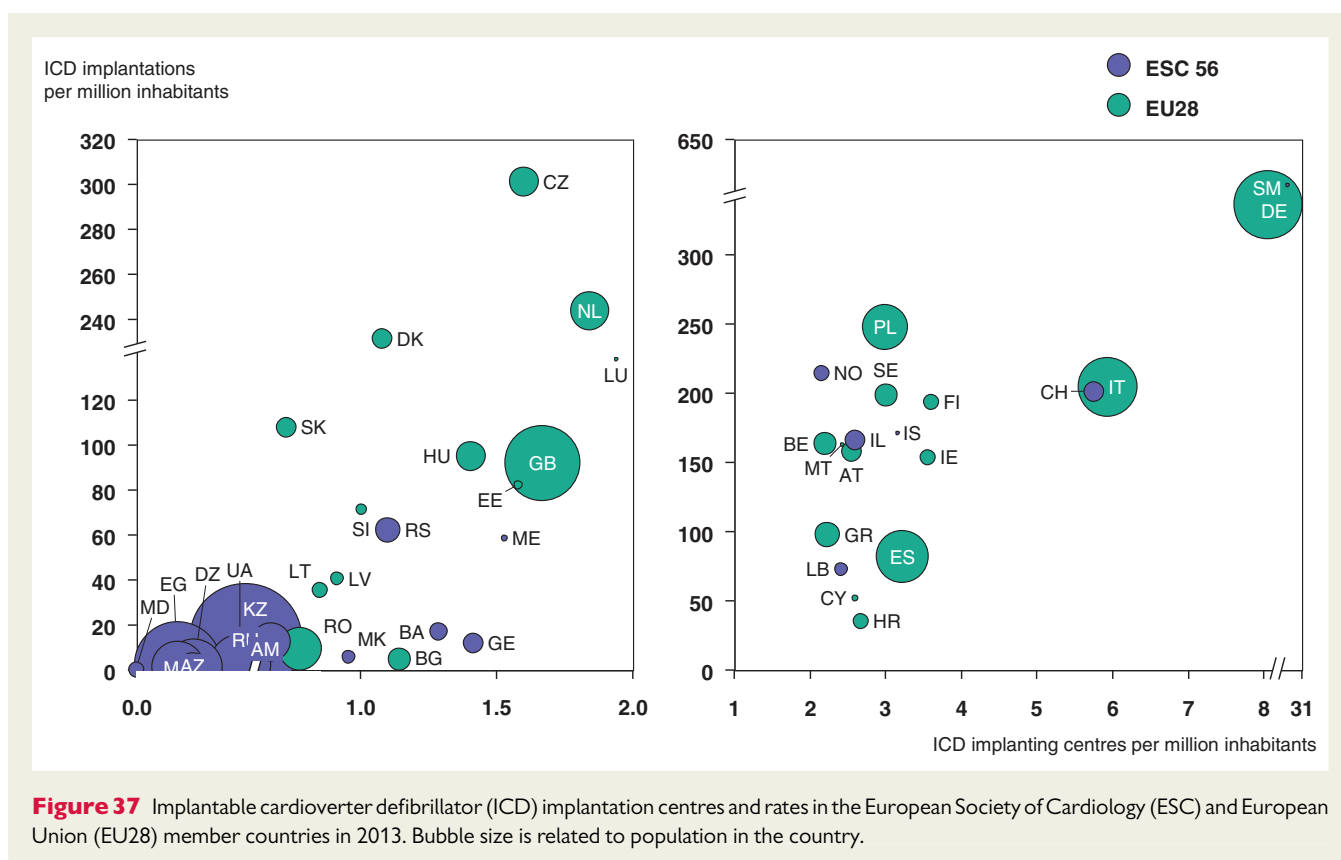


Figure 36 Change in the number of implantable cardioverter defibrillator replacements per million inhabitants from 2012 to 2013.



CRT-Ps per million inhabitants. Italy had the highest implantation rates of CRT-D, followed by Israel, the Czech Republic, and Germany. Denmark had the highest rate of CRT-P implantations and the United Kingdom had the second highest.

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, 45, 46, 47* and *48*, respectively. The number of CRT implantations per million inhabitants was only slightly higher in the Southern than the Northern region. This was followed by the Western region and the non-European ESC countries. As for ICDs the Eastern region had the lowest number of CRT implantations. The most active countries within each region were Italy (198 per million inhabitants), Denmark (180), the Czech Republic (162), Israel (158), and Austria (143), respectively.

The change in the number of implanting centres per million inhabitants between 2012 and 2013 are shown in *Table 12* and *Figure 49*. The changes between 2012 and 2013 for the number of total CRT implantations are shown in *Table 13* and *Figure 50* and the change according to CRT device type are shown in *Figures 51* and *52*. By far the highest growth rate in CRT device implantations per million was in Sweden, with a reported 106% increase between the last two years. Ukraine and Belgium reported a >50% increase in the number of CRT device implantations. In contrast, the number of CRT implantations decreased by >45% in Armenia, Malta, and Montenegro. San Marino did not report any CRT device implantations in 2013, and Germany reported only CRT-D numbers.

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 second year that information on lead extractions (LE) was included in the EHRA White Book. The number of countries submitting data on LE procedures was 31 in 2012 and 30 in 2013 (*Table 14*). Some of the most populated ESC countries, such as Germany, Italy, Russia, and United Kingdom, submitted incomplete or no data on LE. For example, France gave the number of LE centres but not the number of the procedures. In most countries (59%), the primary operator in LE procedures was a cardiologist.

Lead extraction facilities and procedure rates

Data on LE facilities and activities are presented in *Table 14* and *Figure 54*. According to the EHRA White Book data a total of 2655 LE procedures were performed in 193 LE centres in 2013. The density of the LE centres was highest in Luxembourg (1.94 per million inhabitants). Six countries had no LE centres (Bosnia & Herzegovina, Georgia, Iceland, Malta, Montenegro, San Marino). In the countries with high LE rates, the number of centres per million population ranged from 0.41 in Sweden to 0.71 in the Netherlands (*Table 14*). It has been proposed that in an active centre the minimum annual number of LE should be at least 15 per million inhabitants.^{11–13} Assuming that each centre treated an equivalent number of patients it can be calculated that in 2013 the numbers for LE per centre were higher than that in eight countries. The

Table 1 Cardiac resynchronization therapy device (CRT-P and CRT-D) implantation facilities and rates in the ESC countries in 2013 and comparison to four previous years

Country	ISO code	Number of CRT implanting centres 2013		CRT implantations 2013		Total CRT implantations 2013		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 EU-28 level	2009	2010	2011	2012	2013
Albania ^a	AL	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
Algeria	DZ	8	0.21	31	33	64	2	2266	4155	N/A	N/A	N/A	N/A	2
Armenia	AM	2	0.65	0	10	10	3	182	334	3	2	3	6	3
Austria	AT	18	2.19	281	897	1178	143	—	—	113	119	117	107	143
Azerbaijan	AZ	2	0.21	0	17	17	2	570	1046	N/A	2	2	N/A	2
Belarus ^b	BY	5	0.52	N/A	N/A	54	6	573	1050	5	4	5	4	6
Belgium	BE	35	3.35	397	824	1221	117	—	—	N/A	49	58	77	117
Bosnia & Herzegovina	BA	2	0.52	16	9	25	6	231	423	N/A	3	6	5	6
Bulgaria	BG	8	1.15	232	28	260	37	415	762	11	11	12	28	37
Croatia	HR	7	1.56	60	21	81	18	266	488	7	11	12	13	18
Cyprus ^b	CY	3	2.60	N/A	N/A	25	22	69	126	N/A	29	21	25	22
Czech Republic	CZ	17	1.60	435	1281	1716	162	—	—	151	119	143	127	162
Denmark	DK	5	0.90	405	596	1001	180	—	—	116	102	158	170	180
Egypt	EG	13	0.15	339	75	414	5	5074	9305	N/A	3	N/A	4	5
Estonia	EE	2	1.58	41	29	70	55	75	138	15	39	58	53	55
Finland	FI	14	2.66	158	279	437	83	—	575	42	50	62	72	83
France	FR	159	2.41	N/A	N/A	N/A	N/A	N/A	N/A	101	118	123	131	N/A
Georgia	GE	6	1.21	6	34	40	8	294	539	2	3	3	7	8
Germany ^b	DE	465	5.73	N/A	8859	8859	109	—	—	143	177	202	221	109
Greece	GR	16	1.49	50	450	500	46	641	1175	72	33	37	45	46
Hungary	HU	13	1.31	483	501	984	99	—	1084	67	83	81	89	99
Iceland	IS	1	3.17	8	6	14	44	19	34	41	34	48	32	44
Ireland	IE	17	3.56	67	311	378	79	—	521	48	50	57	61	79
Israel	IL	20	2.60	219	997	1216	158	—	—	133	111	97	118	158
Italy	IT	361	5.87	2010	10 138	12 148	198	—	—	169	195	203	194	198

Kazakhstan	KZ	9	0.51	26	183	209	12	1055	1935	N/A	N/A	N/A	9	12
Kosovo ^a	XK	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
Kyrgyzstan ^a	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
Latvia	LV	2	0.92	17	46	63	29	130	238	30	11	24	35	29
Lebanon	LB	5	1.21	10	90	100	24	246	451	N/A	N/A	N/A	N/A	24
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	0.85	134	31	165	47	209	384	27	22	31	39	47
Luxembourg	LU	1	1.94	7	15	22	43	31	56	8	39	40	59	43
FYR Macedonia	MK	2	0.96	11	5	16	8	124	228	9	4	13	5	8
Malta	MT	1	2.43	1	15	16	39	24	45	60	60	56	83	39
Moldova	MD	0	0.00	0	0	0	0	215	395	N/A	N/A	N/A	N/A	0
Montenegro	ME	1	1.53	5	5	10	15	39	71	24	27	21	29	15
Morocco	MA	5	0.15	41	34	75	2	1942	3562	N/A	N/A	N/A	2	2
Netherlands	NL	57	3.39	463	1606	2069	123	–	–	N/A	128	130	124	123
Norway	NO	9	1.77	150	276	426	84	–	555	47	69	88	77	84
Poland	PL	25	0.65	400	2600	3000	78	–	4187	62	61	66	73	78
Portugal	PT	26	2.41	N/A	427	427	N/A	N/A	N/A	35	43	41	52	N/A
Romania	RO	17	0.78	130	70	200	9	1296	2377	7	10	10	7	9
Russian Federation	RU	42	0.29	382	630	1012	7	8477	15 546	3	3	6	6	7
San Marino	SM	1	30.82	0	0	0	0	2	4	69	125	94	62	0
Serbia	RS	6	0.83	282	47	329	45	431	790	35	19	40	42	45
Slovakia	SK	5	0.91	110	342	452	82	–	599	52	74	60	61	82
Slovenia	SI	2	1.00	55	76	131	66	–	217	33	46	45	70	66
Spain	ES	130	2.74	857	1688	2545	54	2818	5168	41	41	56	53	54
Sweden	SE	N/A	N/A	431	536	967	100	–	1052	84	81	N/A	49	100
Switzerland	CH	31	3.88	157	320	477	60	–	872	70	73	74	66	60
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 ^a	TN	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	9	8	8	23	N/A
Turkey ^a	TR	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
Ukraine	UA	13	0.29	67	22	89	2	2652	4863	N/A	1	1	1	2
United Kingdom	GB	109	1.72	3792	3970	7762	122	–	–	95	105	105	110	122
Total		56		12 766	38 429	51 274								

^aThese 10 countries did not submit data on CRT implantations in 2013.

^bBelarus, and Cyprus reported only total CRT implantation numbers and Germany only the numbers for CRT-D implantations.

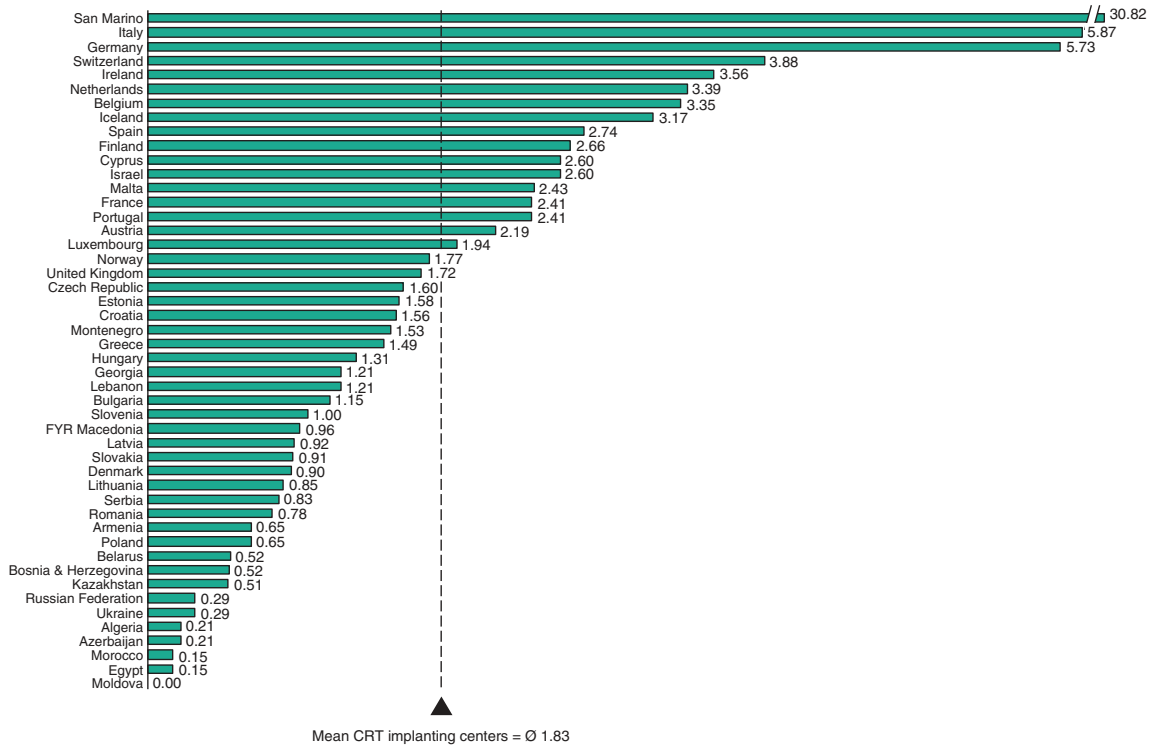


Figure 38 Cardiac resynchronization therapy (CRT) device implanting centres per million inhabitants in 2013. Mean number of CRT implantation centres is weighted by population.

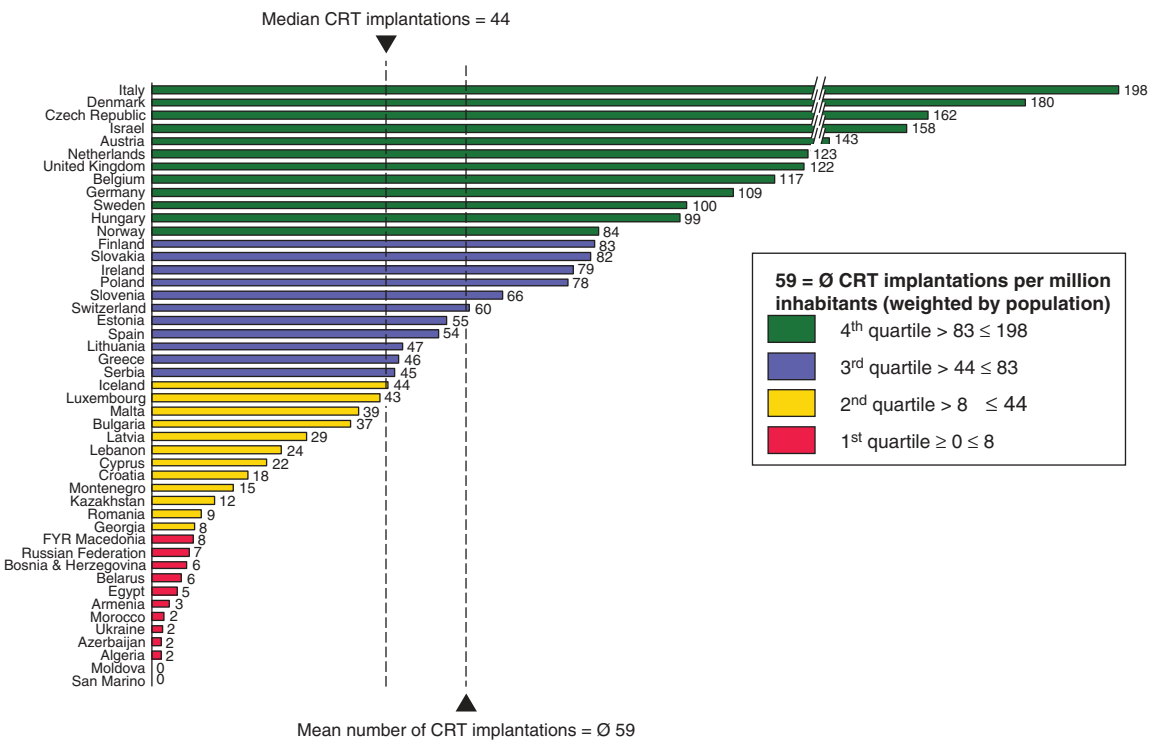


Figure 39 Cardiac resynchronization therapy (CRT) device implantations per million inhabitants 2013.

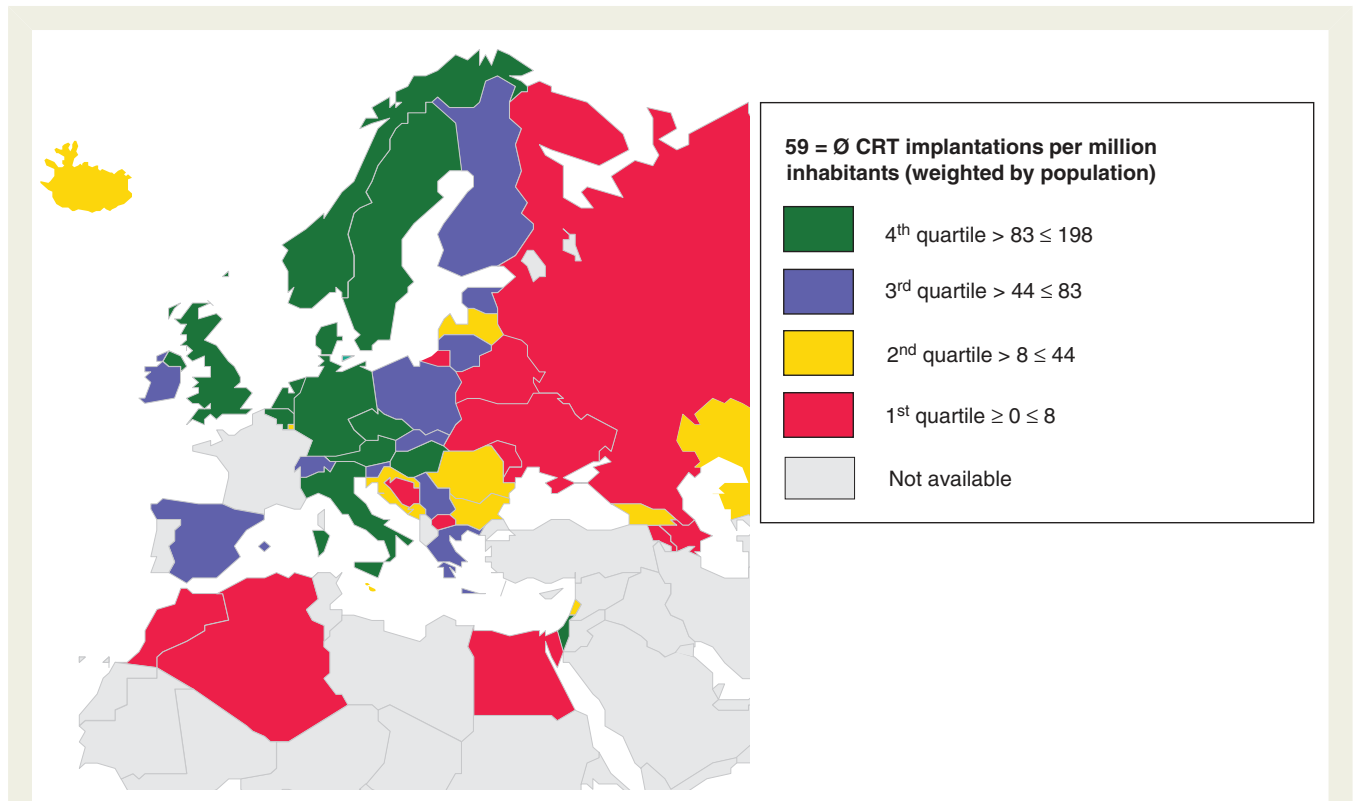


Figure 40 Cardiac resynchronization therapy (CRT) device implantations in the ESC countries in 2013.

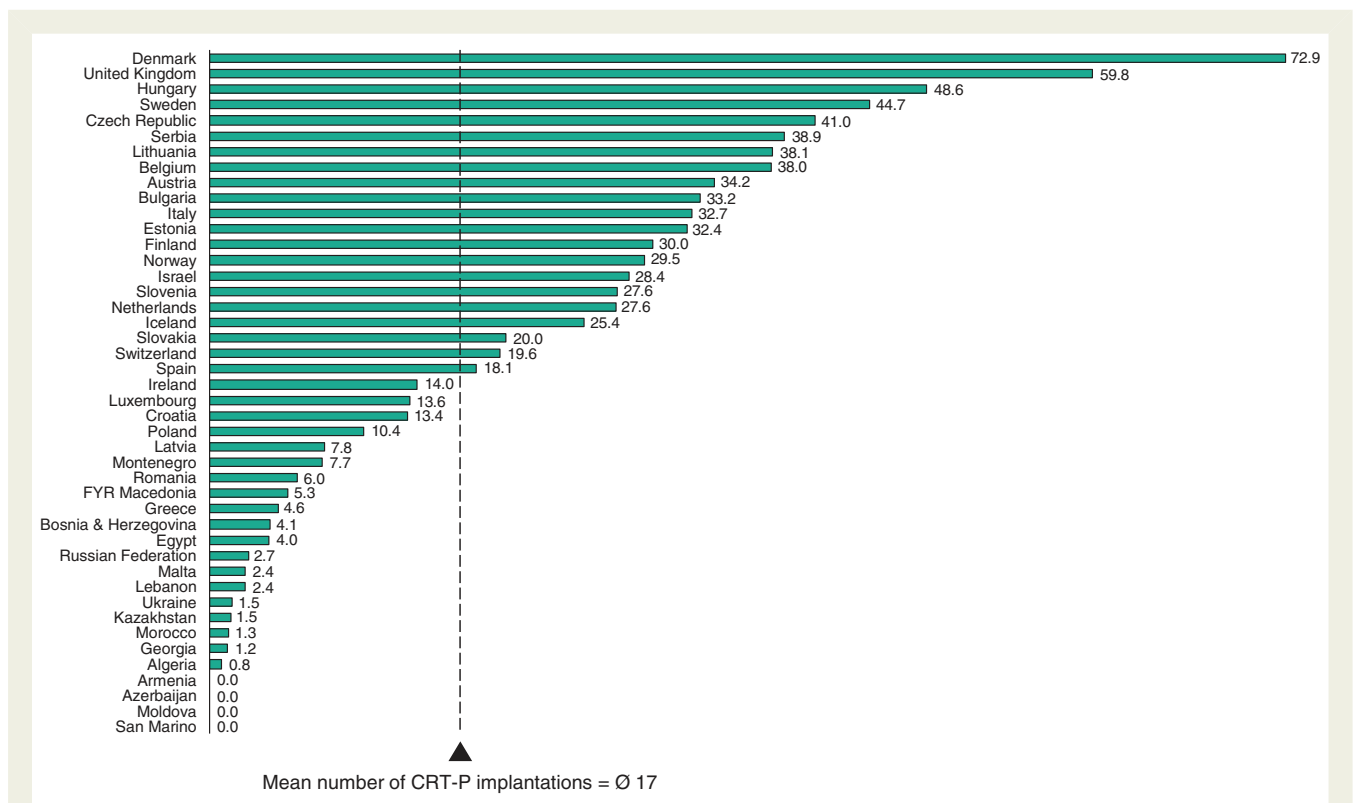


Figure 41 Cardiac resynchronization therapy pacemaker (CRT-P) implantations per million inhabitants in 2013. Mean number of implantations is weighted by population.

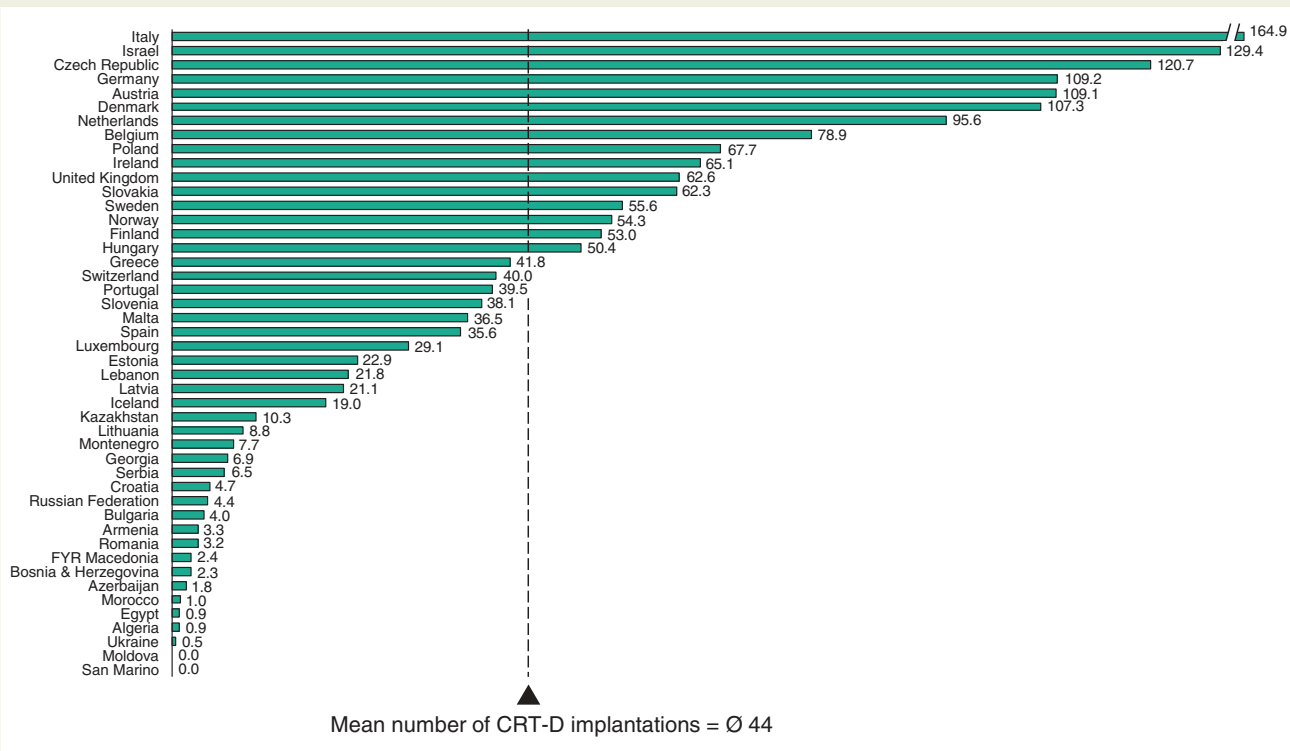


Figure 42 Cardiac resynchronization therapy defibrillator (CRT-D) implantations per million inhabitants in 2013. Mean number of implantations is weighted by population.

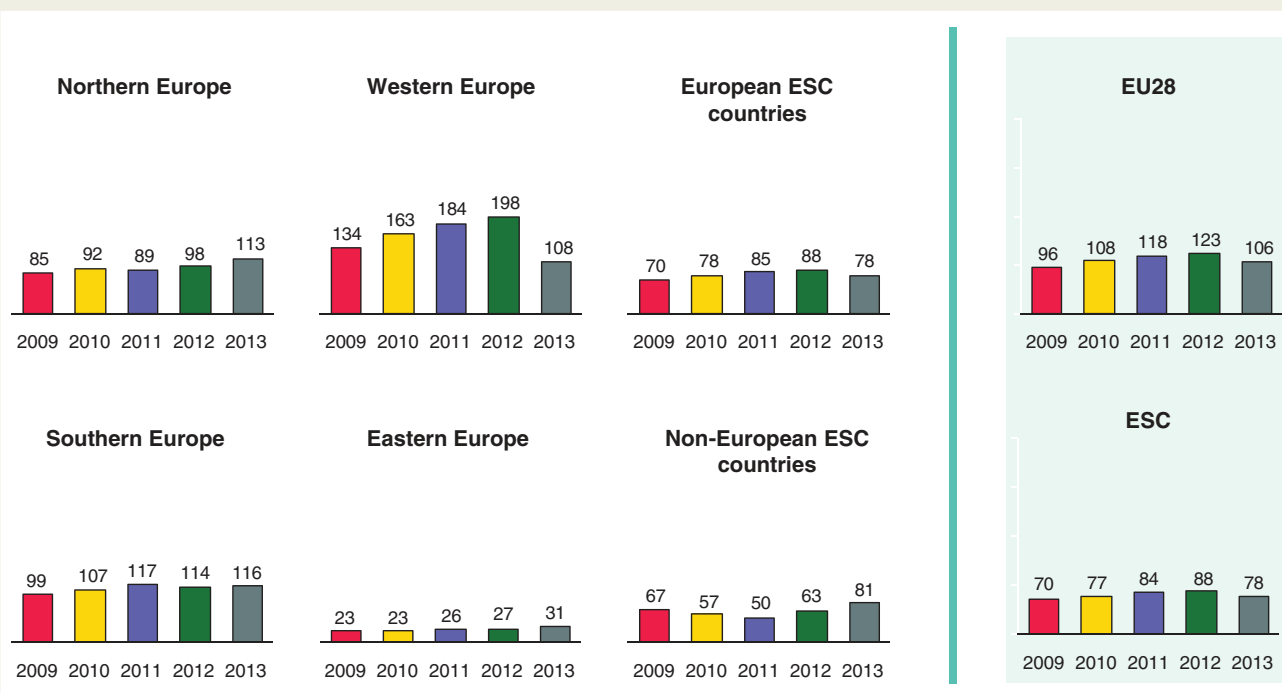


Figure 43 Cardiac resynchronization therapy device (CRT-P and CRT-D) implantations per million inhabitants 2009–2013 in the five geographical regions of the European Society of Cardiology (ESC) and comparison to the total ESC area and the 28 member countries of the European Union (EU28).

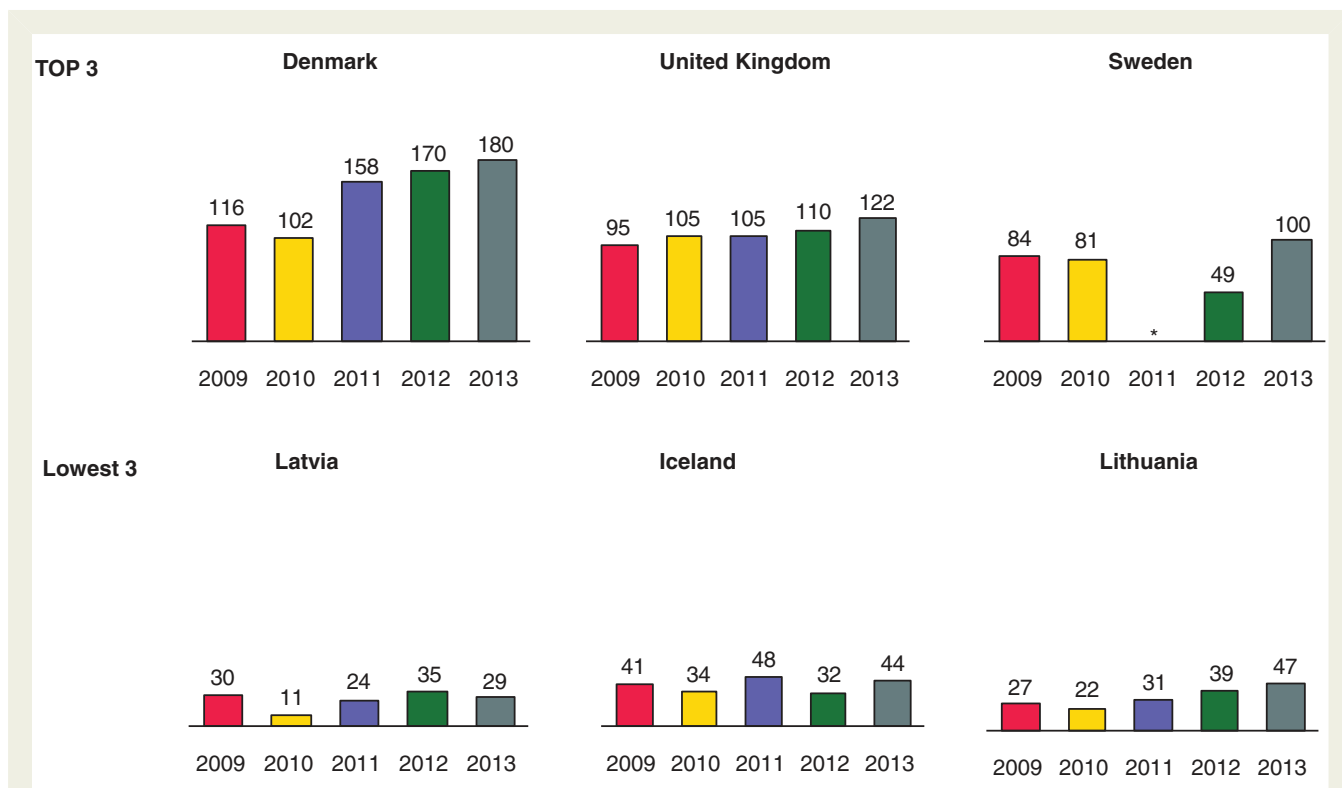


Figure 44 Cardiac resynchronization therapy (CRT-P and CRT-D) implantations per million inhabitants 2009–2013 in Northern Europe. *No data available.

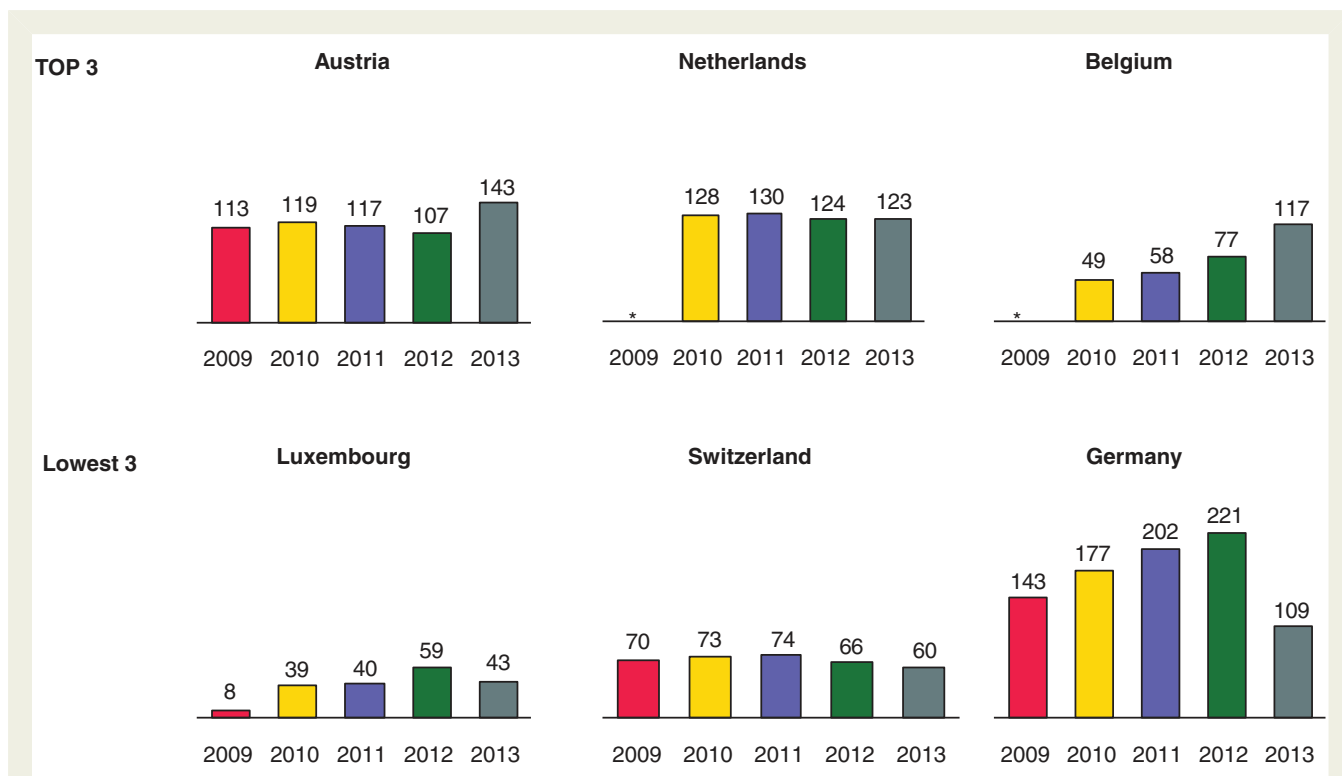


Figure 45 Cardiac resynchronization therapy (CRT-P and CRT-D) implantations per million inhabitants 2009–2013 in Western Europe. *No data available. Germany reported only CRT-D implantation in 2013.

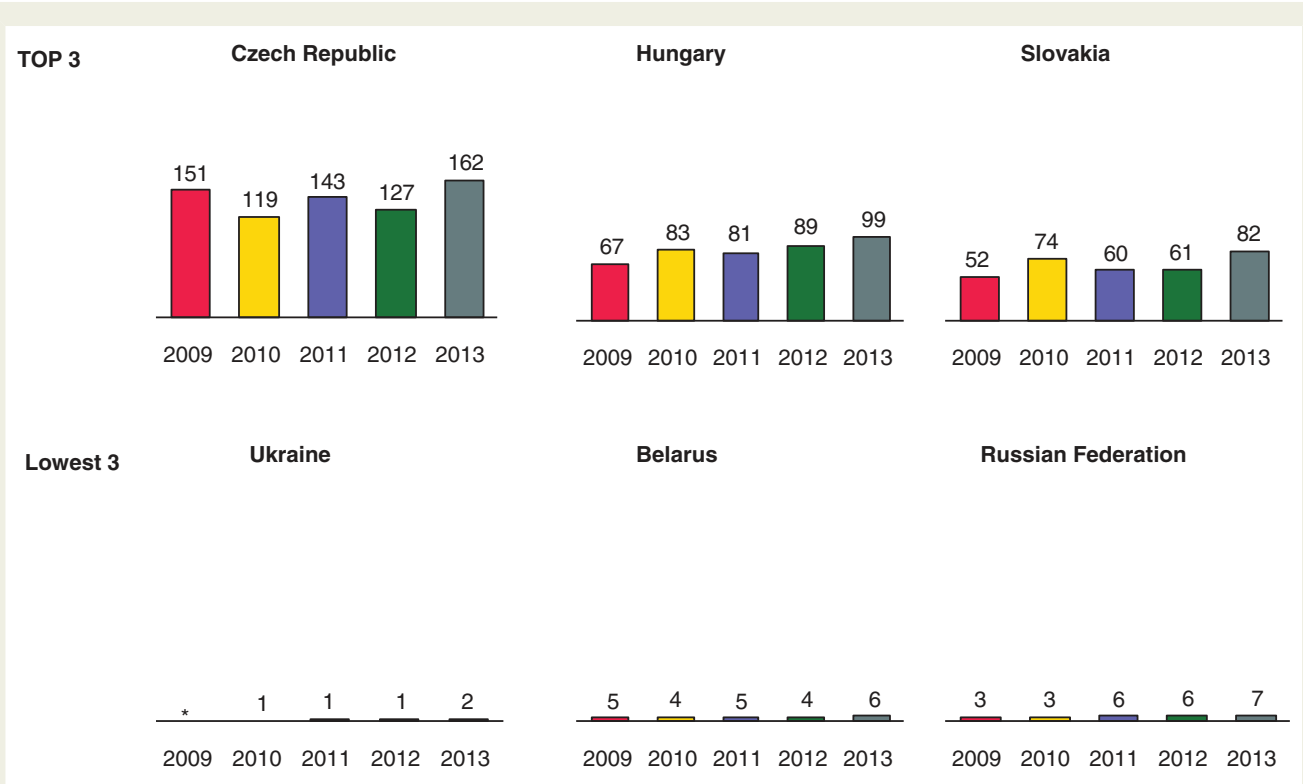


Figure 46 Cardiac resynchronization therapy (CRT-P and CRT-D) implantations per million inhabitants 2009–2013 in Eastern Europe. *No data available.

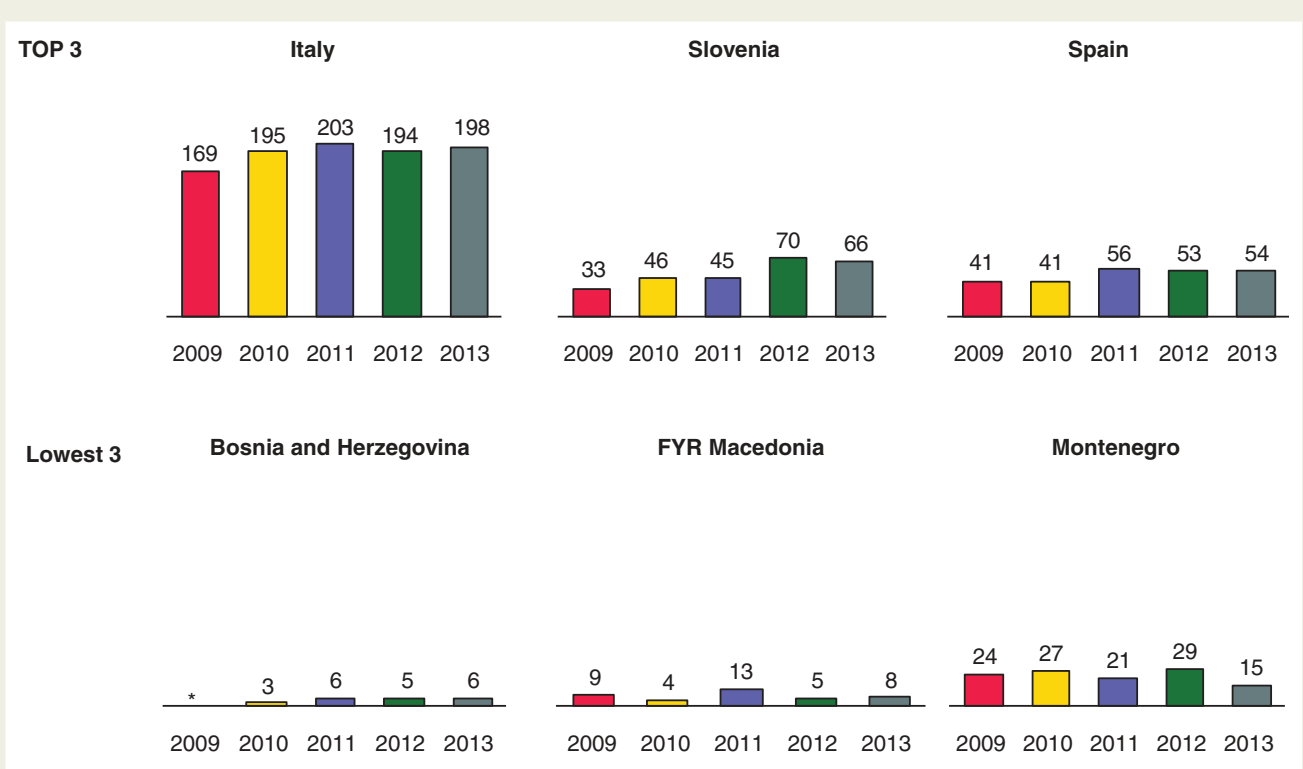


Figure 47 Cardiac resynchronization therapy (CRT-P and CRT-D) implantations per million inhabitants 2009–2013 in Southern Europe. *No data available.

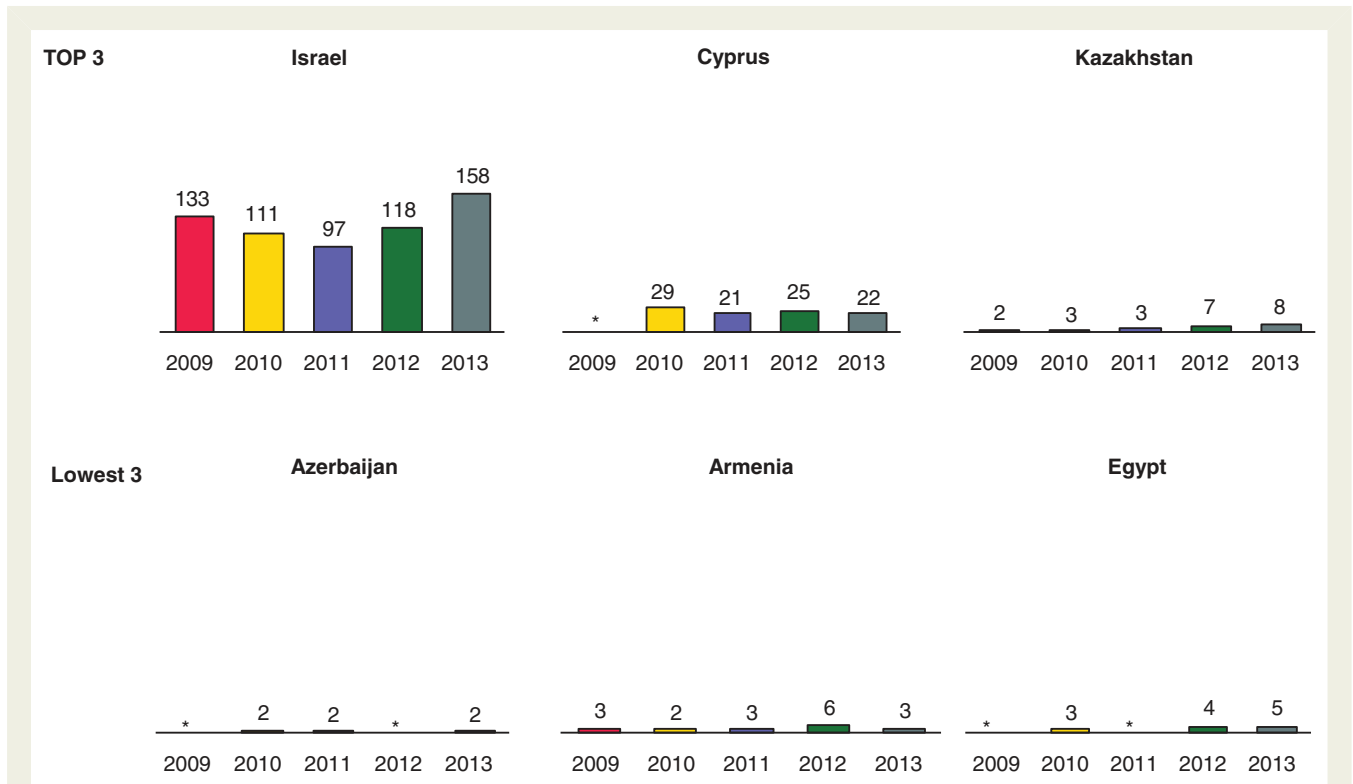


Figure 48 Cardiac resynchronization therapy (CRT-P and CRT-D) implantations per million inhabitants 2009–2013 in Non-European European Society of Cardiology (ESC) countries. *No data available.

mean number of LE per centre was highest in Sweden (122 per million people).

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.^{11–13} In 2013 the LE activity was within this estimate in only six countries (Norway, Sweden, Austria, the Czech Republic, the Netherlands, and Slovakia). Hungary, Poland, and Switzerland were close to the recommended level, but in the others the reported LE rate was far below the estimated need (Figure 54). For example, in Greece the LE rate would have been expected to be >5 times higher than that reported for 2013 (2.8 per million people).

Interpretation of regional LE data is complicated due to the missing data and a very low LE rate in some countries. Therefore, we chose not to present regional data for LE. Nevertheless, on the basis of available data it seems that there were no clear relationship between population size and LE rates.

Catheter ablation

General information

A total of 46 countries (82% of the ESC countries) submitted data on catheter ablation facilities and procedures to the EHRA White Book (Table 15). Twenty-two 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. According to the EHRA White Book, 1 071 549 273 people lived in the ESC countries in 2013. After excluding those that did not report data on the number of ablations or ablation centres, the population covered by the EHRA White Book for ablation procedures was 789 206 090, which is about 5% less than in the previous year. The major problem in 2013 was that no ablation data were received from France and Italy, which are known to have well-developed ablation programmes. The data from Italy have been missing in previous years but this was the only time within the past 5 years that France did not provide ablation statistics.

Ablation facilities and procedure rates

In 2013 the total number of ablation centres in the countries that submitted data for the EHRA White Book was 752, and the mean number of ablation centres per million population was 0.92 (Figure 55). These numbers were lower than in 2012, mainly because the French data were not submitted in 2013. In 2012 there were 195 ablation centres in France. The changes in the number or ablation centres from 2012 to 2013 are shown in Figure 56.

Total number of ablation procedures in the ESC area in 2013 was 144 908 (Table 15), which is 18.5% less than that reported in 2012 (177 782). The mean number of ablations done per million population was also lower in 2013 (184) than in 2012 (216) and 2011 (205) but higher than in 2010 (180) and 2009 (180). The drop in ablation rates was probably due to the fact that data from France was

Table 12 Change in the number of CRT implanting centres in year 2013 vs. 2012

Country	ISO code	Number of CRT implanting centres 2012		Number of CRT implanting centres 2013		Change %
		Absolute number	Per mil inhabitants	Absolute number	Per mil inhabitants	
Albania ^a	AL	N/A	N/A	N/A	N/A	N/A
Algeria	DZ	N/A	N/A	8	0.21	N/A
Armenia	AM	3	1.01	2	0.65	-35%
Austria	AT	18	2.19	18	2.19	0%
Azerbaijan	AZ	N/A	N/A	2	0.21	N/A
Belarus	BY	1	0.10	5	0.52	400.9%
Belgium	BE	37	3.34	35	3.35	0.4%
Bosnia & Herzegovina	BA	2	0.52	2	0.52	0.1%
Bulgaria	BG	4	0.57	8	1.15	102%
Croatia	HR	10	2.23	7	1.56	-30%
Cyprus	CY	3	2.64	3	2.60	-2%
Czech Republic	CZ	19	1.87	17	1.60	-14.2%
Denmark	DK	6	1.08	5	0.90	-17%
Egypt	EG	11	0.13	13	0.15	16.0%
Estonia	EE	2	1.57	2	1.58	1%
Finland	FI	12	2.28	14	2.66	17%
France	FR	159	2.42	159	2.41	0%
Georgia	GE	6	1.31	6	1.21	-8%
Germany	DE	490	6.03	465	5.73	-5%
Greece	GR	16	1.49	16	1.49	0.0%
Hungary	HU	13	1.31	13	1.31	0.2%
Iceland	IS	1	3.19	1	3.17	-1%
Ireland	IE	17	3.60	17	3.56	-1%
Israel	IL	21	2.77	20	2.60	-6%
Italy	IT	350	5.71	361	5.87	2.8%
Kazakhstan	KZ	6	0.34	9	0.51	48%
Kosovo ^a	XK	N/A	N/A	N/A	N/A	N/A
Kyrgyzstan ^a	KGZ	N/A	N/A	N/A	N/A	N/A
Latvia	LV	2	0.91	2	0.92	0.6%
Lebanon	LB	N/A	N/A	5	1.21	N/A
Libya ^a	LY	N/A	N/A	N/A	N/A	N/A
Lithuania	LT	3	0.85	3	0.85	0.3%
Luxembourg	LU	1	1.96	1	1.94	-1.1%
FYR Macedonia	MK	2	0.96	2	0.96	-0.2%
Malta	MT	1	2.44	1	2.43	-0.4%
Moldova	MD	N/A	N/A	0	0.00	N/A
Montenegro	ME	1	1.52	1	1.53	0.6%
Morocco	MA	7	0.22	5	0.15	-29.3%
Netherlands	NL	28	1.67	57	3.39	102.7%
Norway	NO	9	1.80	9	1.77	-1.7%
Poland	PL	21	0.55	25	0.65	19.1%
Portugal	PT	27	3	26	2.41	-3.9%
Romania	RO	15	0.69	17	0.78	14%
Russian Federation	RU	42	0.29	42	0.29	0%
San Marino	SM	1	31.11	1	30.82	-1%

Continued

Table 12 Continued

Country	ISO code	Number of CRT implanting centres 2012		Number of CRT implanting centres 2013		Change %
		Absolute number	Per mil inhabitants	Absolute number	Per mil inhabitants	
Serbia	RS	6	0.82	6	0.83	0.5%
Slovakia	SK	4	0.73	5	0.91	25%
Slovenia	SI	2	1.00	2	1.00	0%
Spain	ES	125	2.66	130	2.74	3.3%
Sweden ^a	SE	33	3.62	N/A	N/A	N/A
Switzerland	CH	34	4.29	31	3.88	-10%
Syria ^a	SY	N/A	N/A	N/A	N/A	N/A
Tunisia ^a	TN	5	0	N/A	N/A	N/A
Turkey ^a	TR	N/A	N/A	N/A	N/A	N/A
Ukraine	UA	11	0.24	13	0.29	20%
United Kingdom	GB	114	1.81	109	1.72	-5%

^aThese eight countries did not submit data on CRT implantation centres for the EHRA White Book 2014.

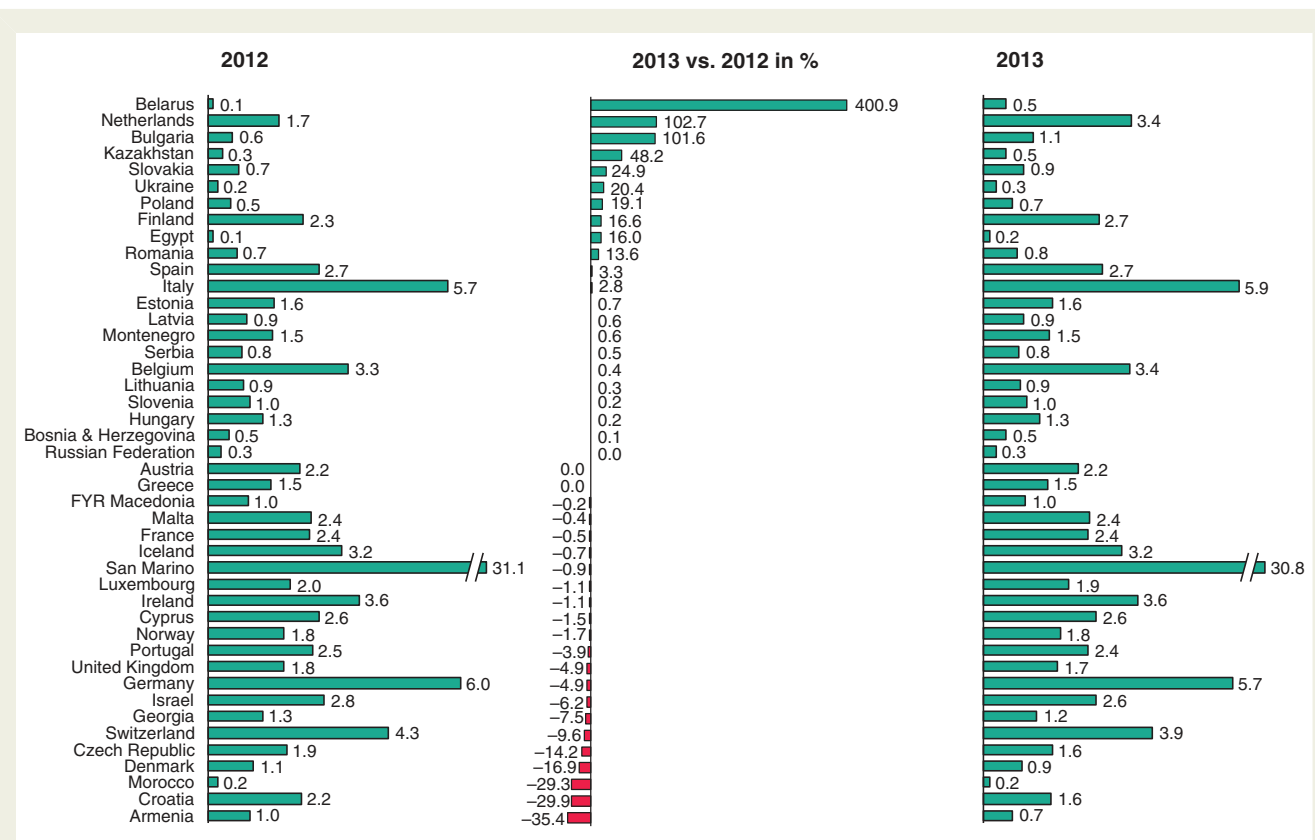


Figure 49 Change in the number of cardiac resynchronization therapy device implanting centres per million inhabitants from 2012 to 2013.

not available and that there was a decrease in the number of ablations (from 38 000 in 2012 to 33 000 in 2013) reported by Germany.

The number of catheter ablations per million inhabitants is shown in Figures 57 and 58. 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

Table 13 Change in the number of total cardiac resynchronization therapy (CRT) device implantations in year 2013 vs. 2012

Country	ISO code	Total CRT implantations 2012		Total CRT implantations 2013		Change %
		Absolute number	Per mil inhabitants	Absolute number	Per mil inhabitants	
Albania ^a	AL	N/A	N/A	N/A	N/A	N/A
Algeria	DZ	N/A	N/A	64	1.68	N/A
Armenia	AM	18	6	10	3.26	-46%
Austria	AT	879	106.94	1178	143.28	34%
Azerbaijan	AZ	N/A	N/A	17	1.77	N/A
Belarus	BY	38	3.94	54	5.61	42.4%
Belgium	BE	858	77.42	1221	116.91	51.0%
Bosnia & Herzegovina	BA	21	5.41	25	6.45	19.2%
Bulgaria	BG	198	28.13	260	37.24	32%
Croatia	HR	58	12.95	81	18.10	40%
Cyprus	CY	28	24.60	25	21.64	-12%
Czech Republic	CZ	1289	126.65	1716	161.74	27.7%
Denmark	DK	941	169.75	1001	180.15	6%
Egypt	EG	354	4.23	414	4.85	14.7%
Estonia	EE	68	53.35	70	55.28	4%
Finland	FI	380	72	437	82.98	15%
France ^a	FR	8605	131.11	N/A	N/A	N/A
Georgia	GE	33	7.22	40	8.09	12%
Germany	DE	17 949	220.76	8859	109.17	-51%
Greece	GR	487	45.23	500	46.41	2.6%
Hungary	HU	884	88.77	984	99.00	11.5%
Iceland	IS	10	31.93	14	44.40	39%
Ireland	IE	286	60.57	378	79.15	31%
Israel	IL	898	118.30	1216	157.78	33%
Italy	IT	11 900	194.25	12 148	197.59	1.7%
Kazakhstan	KZ	153	8.73	209	11.78	35%
Kosovo ^a	XK	N/A	N/A	N/A	N/A	N/A
Kyrgyzstan ^a	KGZ	N/A	N/A	N/A	N/A	N/A
Latvia	LV	76	34.68	63	28.92	-16.6%
Lebanon	LB	N/A	N/A	100	24.20	N/A
Libya ^a	LY	N/A	N/A	N/A	N/A	N/A
Lithuania	LT	139	39.42	165	46.93	19.0%
Luxembourg	LU	30	58.93	22	42.73	-27.5%
FYR Macedonia	MK	11	5.28	16	7.67	45.1%
Malta	MT	34	82.96	16	38.90	-53.1%
Moldova	MD	N/A	N/A	0	0.00	N/A
Montenegro	ME	19	28.90	10	15.30	-47.1%
Morocco	MA	57	1.76	75	2.30	30.2%
Netherlands	NL	2076	124.08	2069	123.12	-0.8%
Norway	NO	383	76.60	426	83.77	9.4%
Poland	PL	2788	72.58	3000	78.16	7.7%
Portugal ^a	PT	564	52	N/A	N/A	N/A
Romania	RO	163	7.46	200	9.18	23%
Russian Federation	RU	911	6.39	1012	7.10	11%
San Marino	SM	2	62.23	0	0.00	-100%
Serbia	RS	303	41.64	329	45.42	9.1%

Continued

Table 13 Continued

Country	ISO code	Total CRT implantations 2012		Total CRT implantations 2013		Change %
		Absolute number	Per mil inhabitants	Absolute number	Per mil inhabitants	
Slovakia	SK	332	60.55	452	82.36	36%
Slovenia	SI	139	69.62	131	65.74	−6%
Spain	ES	2490	52.93	2545	53.73	1.5%
Sweden	SE	443	48.66	967	100.23	106%
Switzerland	CH	520	65.61	477	59.65	−9%
Syria ^a	SY	N/A	N/A	N/A	N/A	N/A
Tunisia ^a	TN	250	23	N/A	N/A	N/A
Turkey ^a	TR	N/A	N/A	N/A	N/A	N/A
Ukraine	UA	57	1.26	89	2.00	59%
United Kingdom	GB	6965	110.47	7762	122.44	11%

^aThese nine countries did not submit data on total CRT implantations for the EHRA White Book 2014.

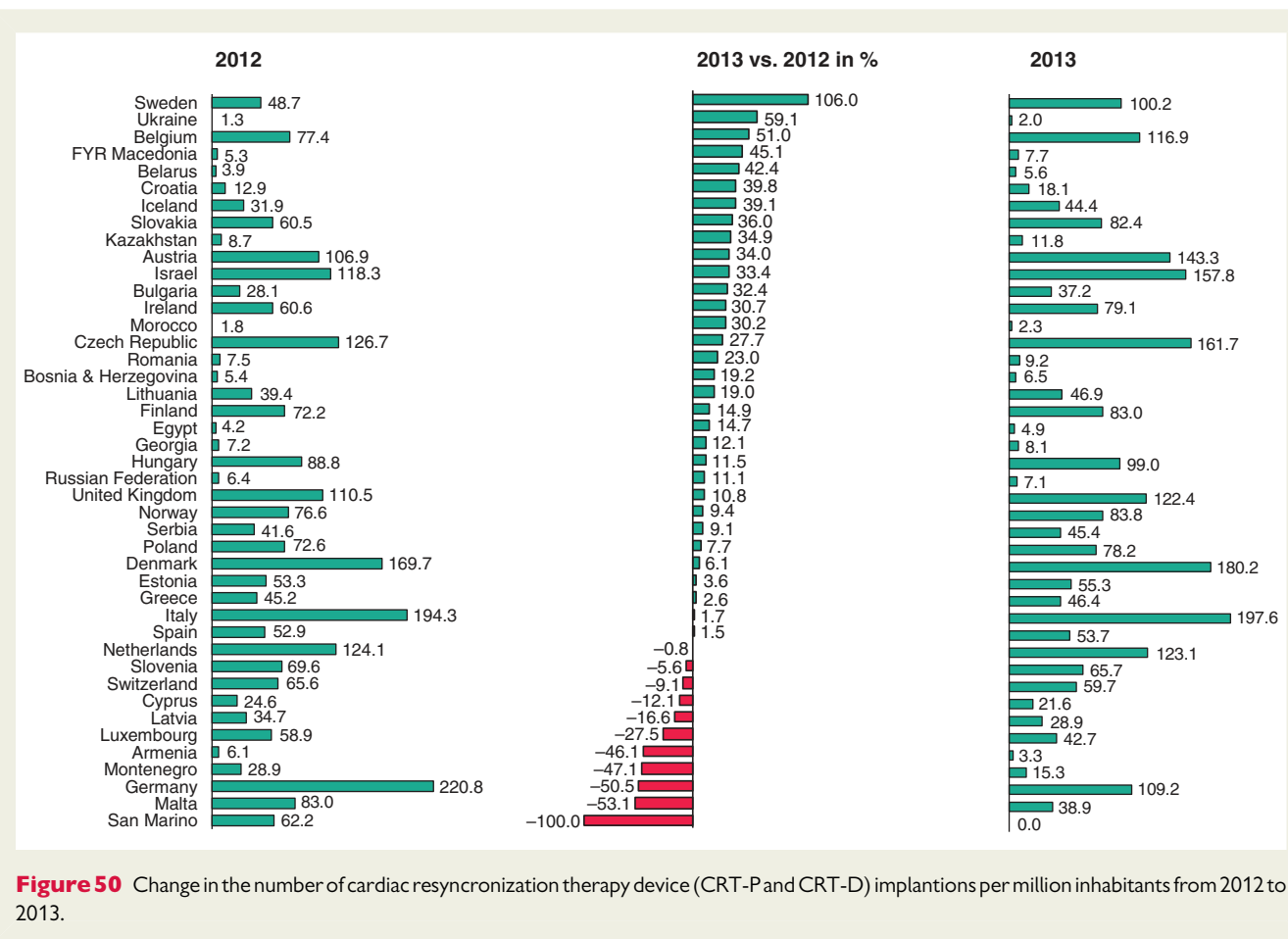


Figure 50 Change in the number of cardiac resynchronization therapy device (CRT-P and CRT-D) implantations per million inhabitants from 2012 to 2013.

in the lowest (1st) quartile. Eastern European countries had a heterogeneous distribution, which spanned over the four quartiles. Detailed information on changes in ablations numbers in the ESC countries during the last five years is shown in Table 15. Changes in the

number of ablation procedures from 2012 to 2013 are shown in Figure 59. The mean number of ablations performed per centre increased from 175 in 2012 to 193 in 2013 indicating that those centres that did report their numbers were more active than in the

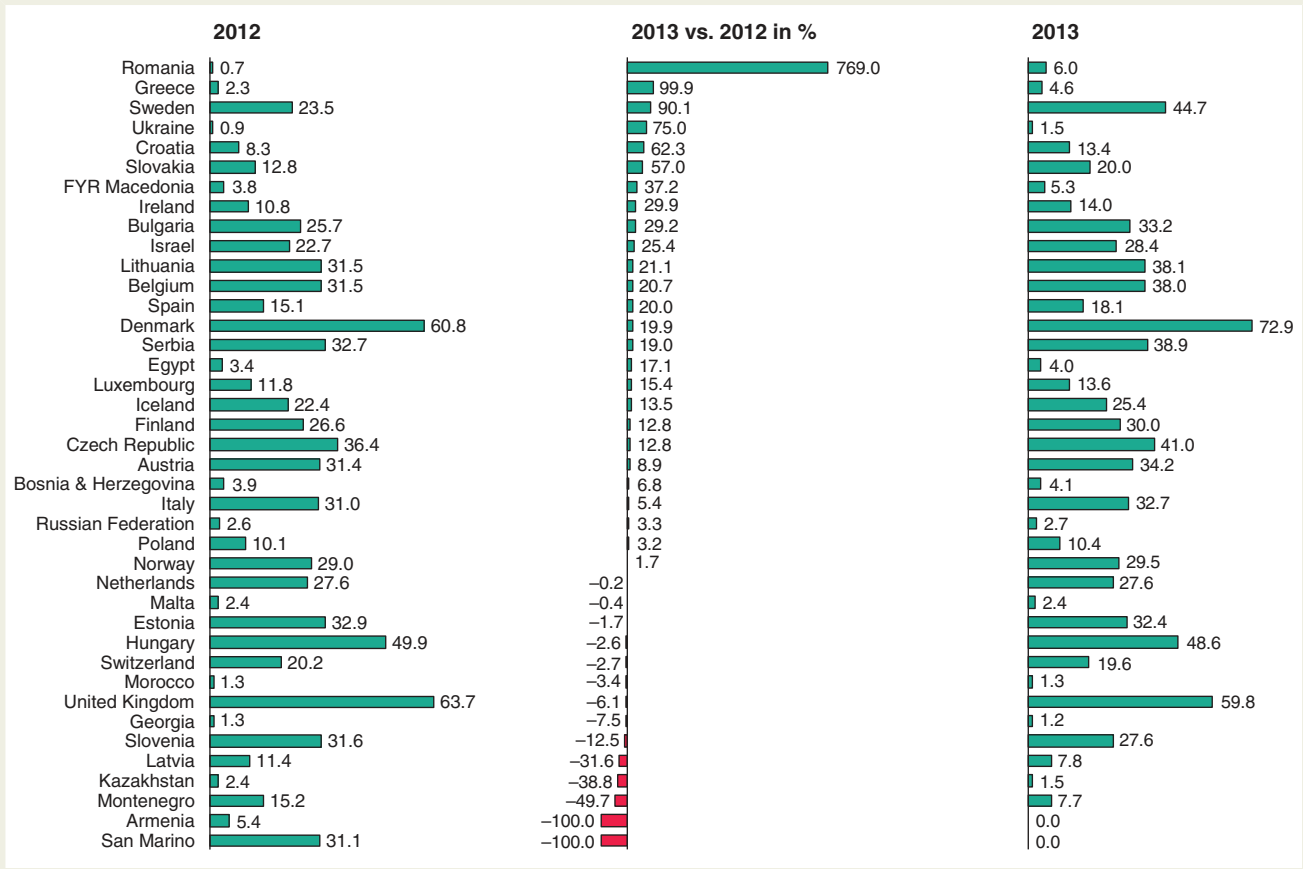


Figure 51 Change in the number of cardiac resynchronization pacemaker (CRT-P) implantations per million inhabitants from 2012 to 2013.

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 60*.

More detailed data on ablation activity in the five geographical ESC regions are presented in *Figure 61*. The mean number of ablations per million inhabitants was higher in the Western and Northern 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 (50 vs. 257 per million population). In 2013, the most active ESC country was Denmark with 652 ablations per million population (*Table 15* and *Figure 54*). 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 62, 63, 64, 65* and *66*. The most active countries in the Northern, Western, Southern and Eastern Europe were Denmark (652 ablation per million inhabitants), Belgium (580), Spain (253), and Czech Republic (482), respectively. Among the non-European ESC countries Kazakhstan was the most active with 83 catheter ablation per million population. The growth in the mean ablation rate per million population was highest in the Eastern and Southern European region. In Armenia, the increase in ablation rate was almost 103%, whereas in many Western countries the ablation rate decreased. For example, in Germany and Austria, the decrease in ablation rate was 11.9% and 13.2%, respectively (*Figure 56*).

In 2013 a total of 43 611 atrial fibrillation (AF) ablations were performed in the 44 ESC countries that submitted AF ablation data for the EHRA White Book (*Table 16*). In *Figures 67* and *68* countries performing AF ablations are grouped into quartiles according to their activity. The mean number of AF ablations per million inhabitants was 58, which is almost exactly the same as in 2012 (59). The most active countries were Norway (293 AF ablations per million population) and Denmark (290). Like 2012 most countries in the top quartile were from Northern and Western European region, and the countries with the lowest activity (1st and 2nd quartiles) were mainly from the Southern Europe and outside Europe. In the Eastern region the AF ablations activity was extremely heterogeneous. The growth in AF ablation rate per million population was highest in Croatia (117%) and Estonia (110%), whereas in Georgia, Austria, and Germany the AF ablation rate decreased by 34%, 23%, and 16%, respectively (*Figure 69*).

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 70*. In keeping with total ablation numbers the rate of AF ablations was markedly lower in the non-European than in the European ESC countries (82 vs. 5 per million population). The number of AF ablations per million inhabitants was 3–4 times higher in the Northern and Western than in the Southern and Eastern European regions. The most active countries in the Northern, Western,

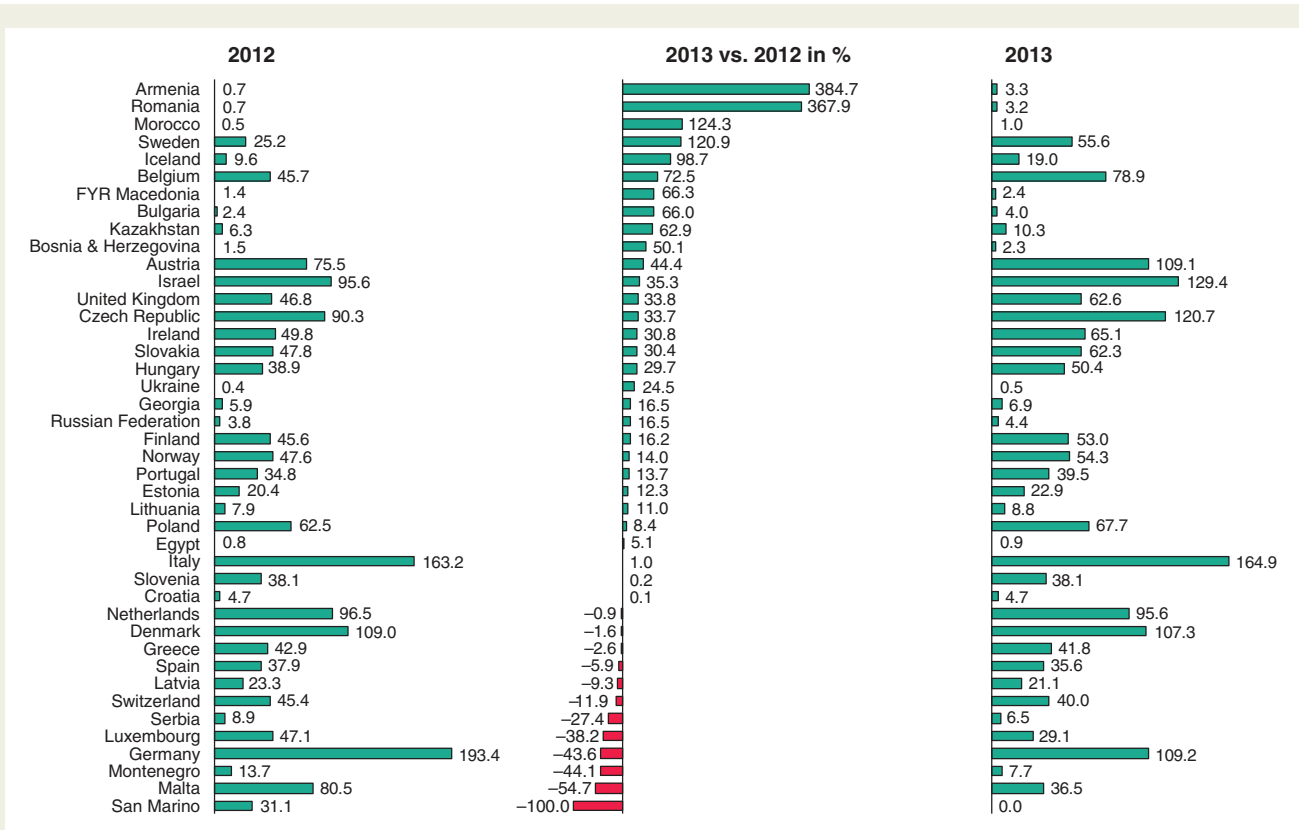


Figure 52 Change in the number of cardiac resynchronization therapy (CRT-D) implantations per million inhabitants from 2012 to 2013.

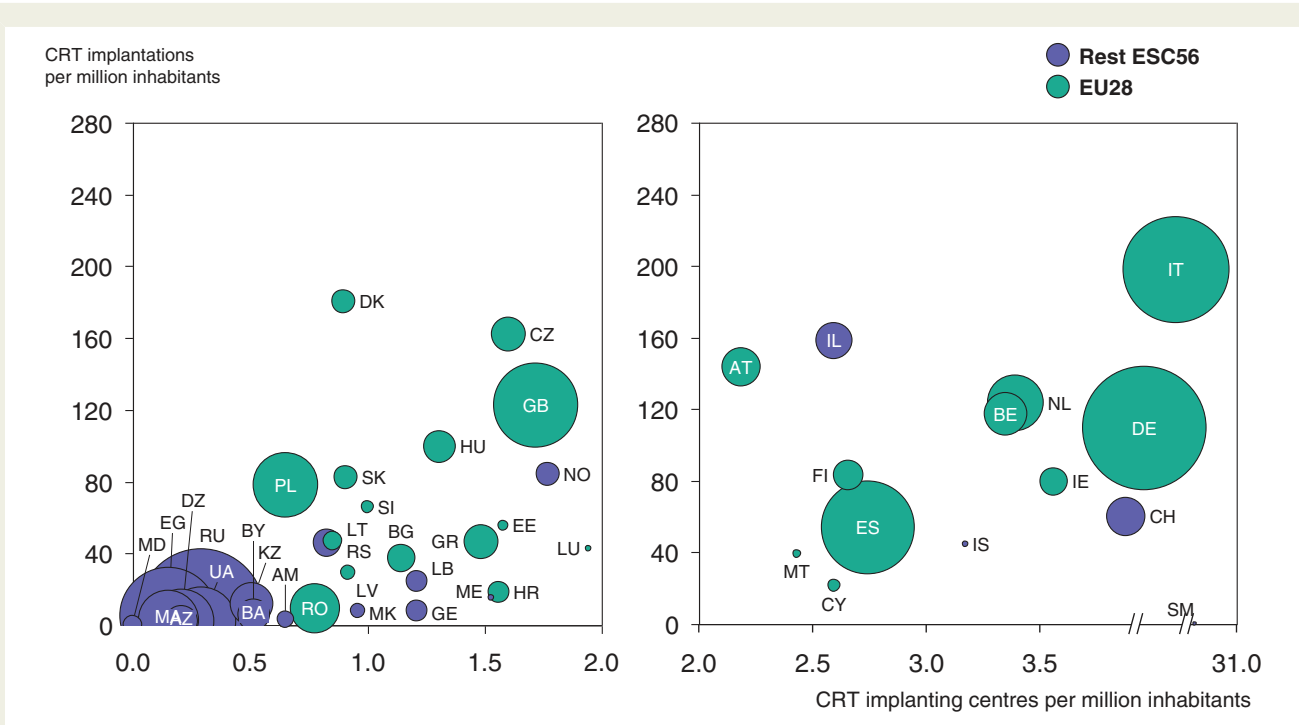


Figure 53 Cardiac resynchronization therapy (CRT) implantation centres and rates in the European Society of Cardiology (ESC) and European Union (EU28) member countries in 2013. Bubble size is related to population in the country.

Table 14 Lead extraction facilities and rates in the ESC countries in 2013 and comparison to the previous year

Country	ISO code	Number of Lead extraction centres 2013		Lead extraction procedures 2013		Development potential—target number of lead extraction procedures ...		Lead extraction procedures per mil inhabitants	
		Absolute number	per mil inhabitants	Absolute number	Per mil inhabitants	To attain mean ESC area level	To attain mean EU-28 level	2012	2013
Albania ^a	AL	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Algeria ^a	DZ	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Armenia	AM	1	0.33	3	1	18	29	0	1
Austria	AT	5	0.61	250	30	–	–	27	30
Azerbaijan	AZ	1	0.10	10	1	58	92	N/A	1
Belarus ^b	BY	10	1.04	N/A	N/A	N/A	N/A	4	N/A
Belgium ^a	BE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Bosnia & Herzegovina	BA	0	0.00	0	0	23	37	N/A	0
Bulgaria	BG	1	0.14	11	2	42	67	N/A	2
Croatia	HR	3	0.67	0	0	27	43	2	0
Cyprus	CY	1	0.87	2	2	7	11	0	2
Czech Republic	CZ	5	0.47	320	30	–	–	29	30
Denmark ^b	DK	4	0.72	N/A	N/A	N/A	N/A	N/A	N/A
Egypt	EG	2	0.02	15	0	512	819	0	0
Estonia ^a	EE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Finland ^b	FI	5	0.95	N/A	N/A	N/A	N/A	N/A	N/A
France	FR	50	0.76	N/A	N/A	N/A	N/A	30	N/A
Georgia	GE	0	0.00	0	0	30	47	N/A	0
Germany	DE	N/A	N/A	N/A	N/A	487	779	10	N/A
Greece	GR	4	0.37	30	3	65	103	2	3
Hungary	HU	7	0.70	126	13	–	–	7	13
Iceland	IS	0	0.00	0	0	2	3	0	0
Ireland ^b	IE	2	0.42	N/A	N/A	N/A	N/A	N/A	N/A
Israel ^b	IL	5	0.65	N/A	N/A	N/A	N/A	0	N/A
Italy ^a	IT	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Kazakhstan ^b	KZ	2	0.11	N/A	N/A	N/A	N/A	0	N/A
Kosovo ^a	XK	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Kyrgyzstan ^a	KGZ	N/A	N/A	N/A	N/A	N/A	N/A	0	N/A
Latvia	LV	1	0.46	8	4	13	21	3	4
Lebanon	LB	5	1.21	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
Lithuania	LT	2	0.57	11	3	21	34	3	3
Luxembourg	LU	1	1.94	N/A	N/A	N/A	N/A	18	N/A
FYR Macedonia	MK	2	0.96	0	0	13	20	3	0
Malta	MT	0	0.00	0	0	2	4	0	0
Moldova	MD	1	0.28	2	1	22	35	N/A	1
Montenegro	ME	0	0.00	0	0	4	6	0	0
Morocco	MA	2	0.06	10	0	196	313	0	0
Netherlands	NL	12	0.71	405	24	–	–	N/A	24
Norway	NO	3	0.59	214	42	–	–	36	42
Poland	PL	7	0.18	450	12	–	–	14	12
Portugal ^b	PT	5	0.46	N/A	N/A	N/A	N/A	N/A	N/A
Romania	RO	2	0.09	10	0	131	209	0	0
Russian Federation ^b	RU	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Continued

Table 14 Continued

Country	ISO code	Number of Lead extraction centres 2013		Lead extraction procedures 2013		Development potential—target number of lead extraction procedures ...		Lead extraction procedures per mil inhabitants	
		Absolute number	per mil inhabitants	Absolute number	Per mil inhabitants	To attain mean ESC area level	To attain mean EU-28 level	2012	2013
San Marino	SM	0	0.00	0	0	0	0	0	0
Serbia	RS	3	0.41	34	5	43	70	7	5
Slovakia	SK	3	0.55	108	20	–	–	25	20
Slovenia ^b	SI	1	0.50	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
Sweden	SE	4	0.41	491	51	–	–	22	51
Switzerland	CH	8	1.00	90	11	–	–	N/A	11
Syria ^a	SY	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tunisia ^a	TN	N/A	N/A	N/A	N/A	N/A	N/A	7	N/A
Turkey ^a	TR	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Ukraine	UA	7	0.16	55	1	267	428	1	1
United Kingdom ^b	GB	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total ESC countries		193		2655					

^aThese 10 countries submitted no data on lead extraction.

^bThese 11 countries gave only the number of LE centers for the EHRA White Book 2014.

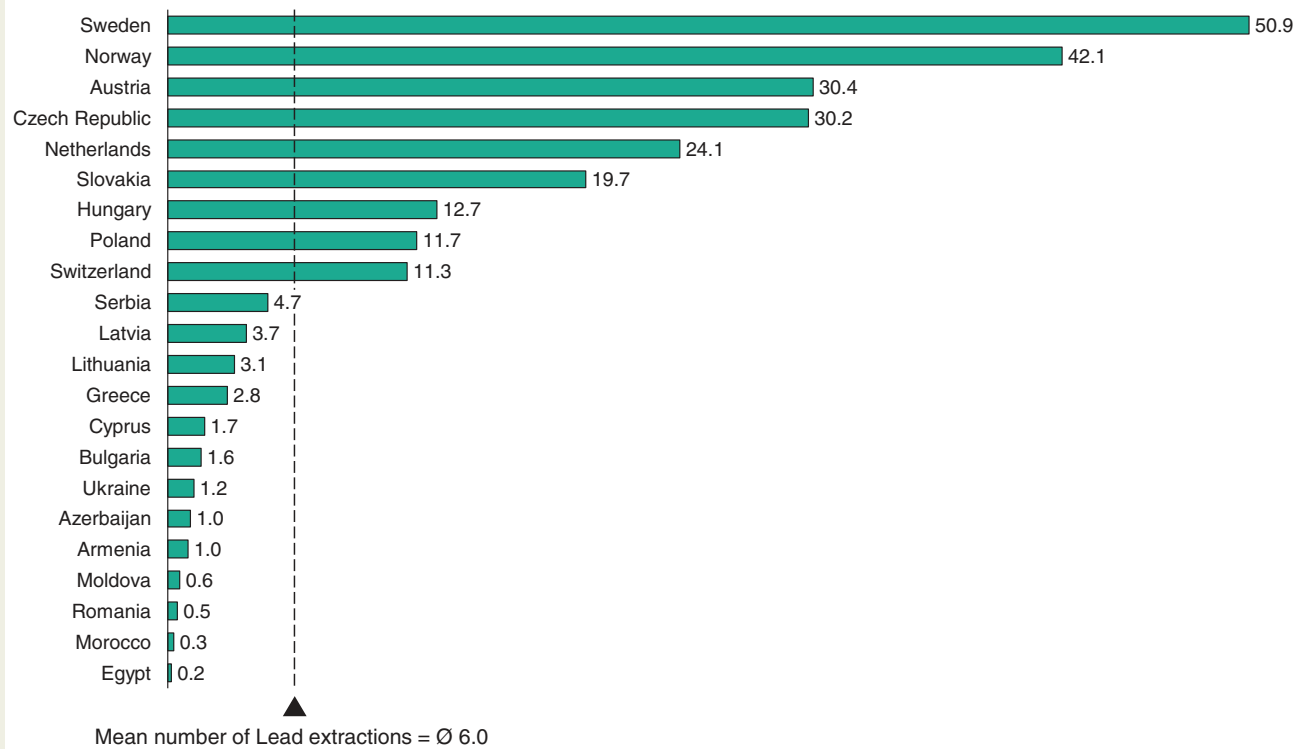


Figure 54 Lead extractions per million inhabitants in 2013. Mean number of lead extractions is weighted by population.

Kyrgyzstan ^a	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
Latvia	LV	Yes	2	0.92	518	238	–	645	140	175	247	269	238	
Lebanon	LB	No	5	1.21	100	24	759	1223	N/A	N/A	N/A	N/A	24	
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	0.85	840	239	–	1040	235	242	227	243	239	
Luxembourg	LU	Yes	1	1.94	129	251	–	152	220	183	252	301	251	
FYR Macedonia	MK	Yes	3	1.44	80	38	383	618	34	15	26	30	38	
Malta	MT	Yes	1	2.43	12	29	76	122	36	31	20	24	29	
Moldova	MD	No	0	0.00	0	0	665	1071	N/A	N/A	N/A	N/A	0	
Montenegro	ME	No	1	1.53	45	69	120	193	0	0	11	149	69	
Morocco	MA	Yes	4	0.12	150	5	5995	9662	N/A	2	3	7	5	
Netherlands	NL	Yes	16	0.95	N/A	N/A	N/A	N/A	N/A	344	N/A	382	N/A	
Norway	NO	No	5	0.98	2578	507	–	–	242	262	487	530	507	
Poland	PL	No	75	1.95	9500	248	–	11 359	167	200	214	229	248	
Portugal	PT	Yes	16	1.48	2062	191	–	3196	157	152	187	186	191	
Romania	RO	Yes	14	0.64	1300	60	4001	6448	42	47	50	50	60	
Russian Federation	RU	Yes	81	0.57	21 185	149	26 165	42 170	94	98	118	120	149	
San Marino	SM	Yes	0	0.00	0	0	6	10	0	0	0	0	0	
Serbia	RS	No	3	0.41	1010	139	1330	2143	115	112	125	133	139	
Slovakia	SK	Yes	4	0.73	1071	195	–	1624	164	176	177	168	195	
Slovenia	SI	Yes	2	1.00	279	140	366	590	120	129	162	136	140	
Spain	ES	Yes	80	1.69	11 987	253	–	14 018	170	190	188	205	253	
Sweden	SE	Yes	10	1.04	4483	465	–	–	313	378	450	478	465	
Switzerland	CH	Yes	22	2.75	4527	566	–	–	506	511	612	598	566	
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 ^a	TN	N/A	N/A	N/A	N/A	N/A	N/A	N/A	49	48	56	47	N/A	
Turkey ^a	TR	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Ukraine	UA	No	13	0.29	2672	60	8184	13 190	N/A	41	47	55	60	
United Kingdom	GB	Yes	54	0.85	15 903	251	–	18 761	227	229	240	254	251	
Total ESC countries			752		144 908									

^aThese nine countries did not submit data on catheter ablations for the EHRA White Book 2014.

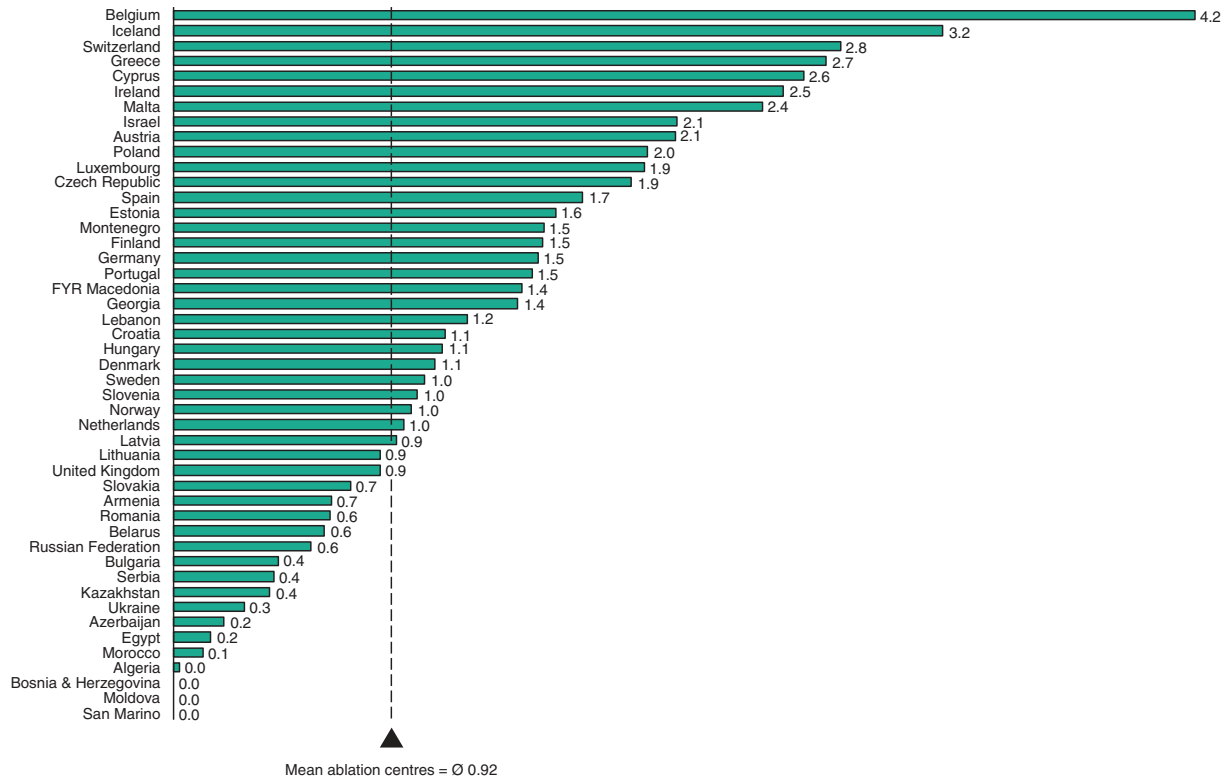


Figure 55 Catheter ablation centres per million inhabitants in 2013. Mean number of ablation centres is weighted by population.

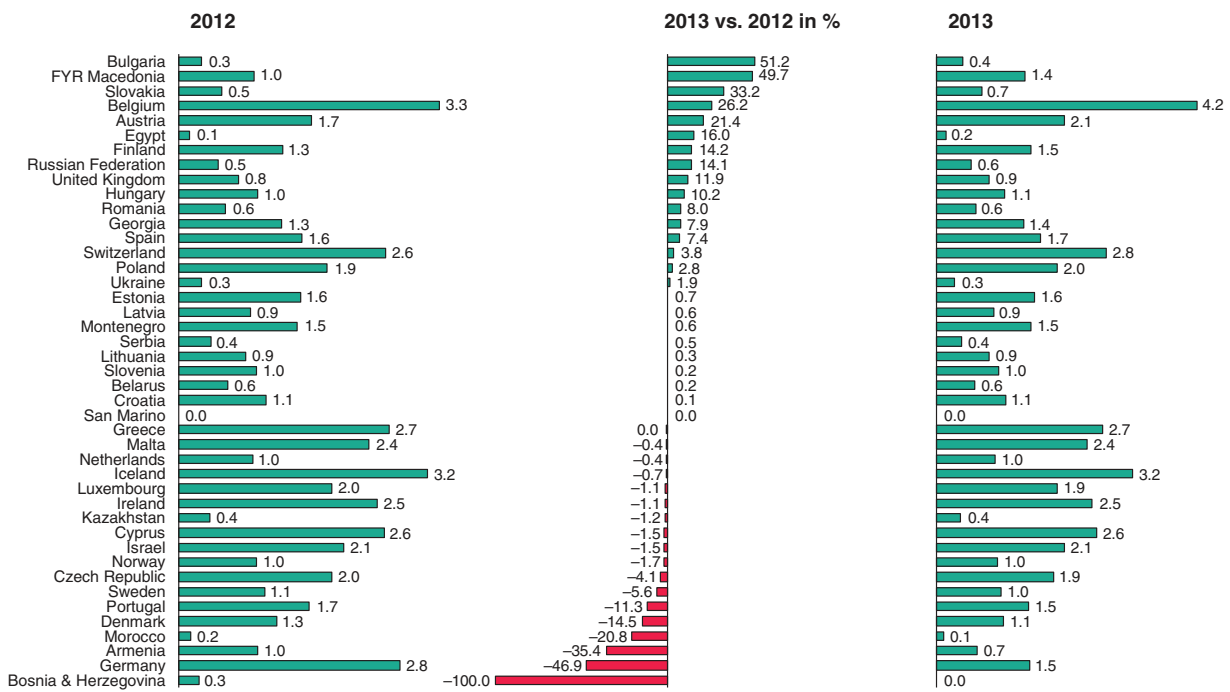


Figure 56 Change in the number of catheter ablation centres per million inhabitants from 2012 to 2013.

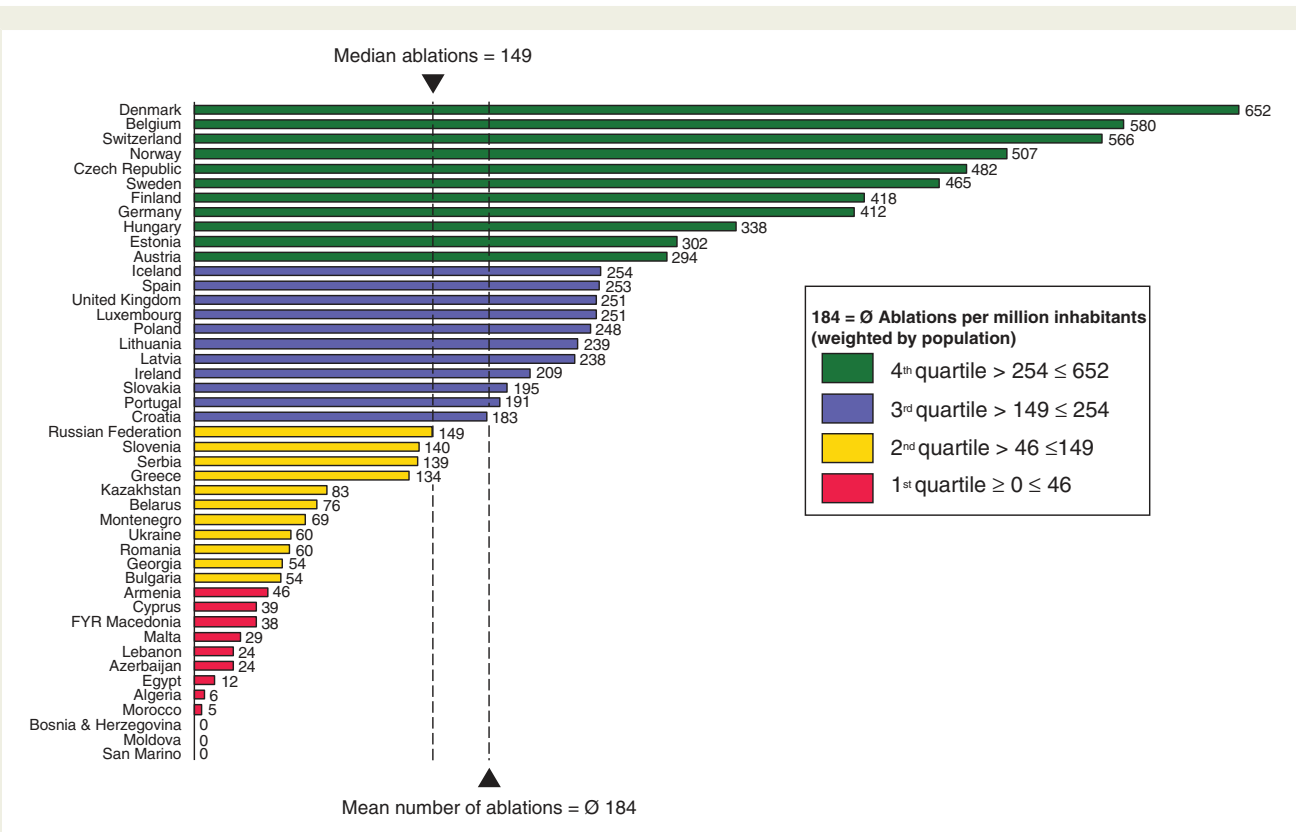


Figure 57 Catheter ablations per million inhabitants in 2013.

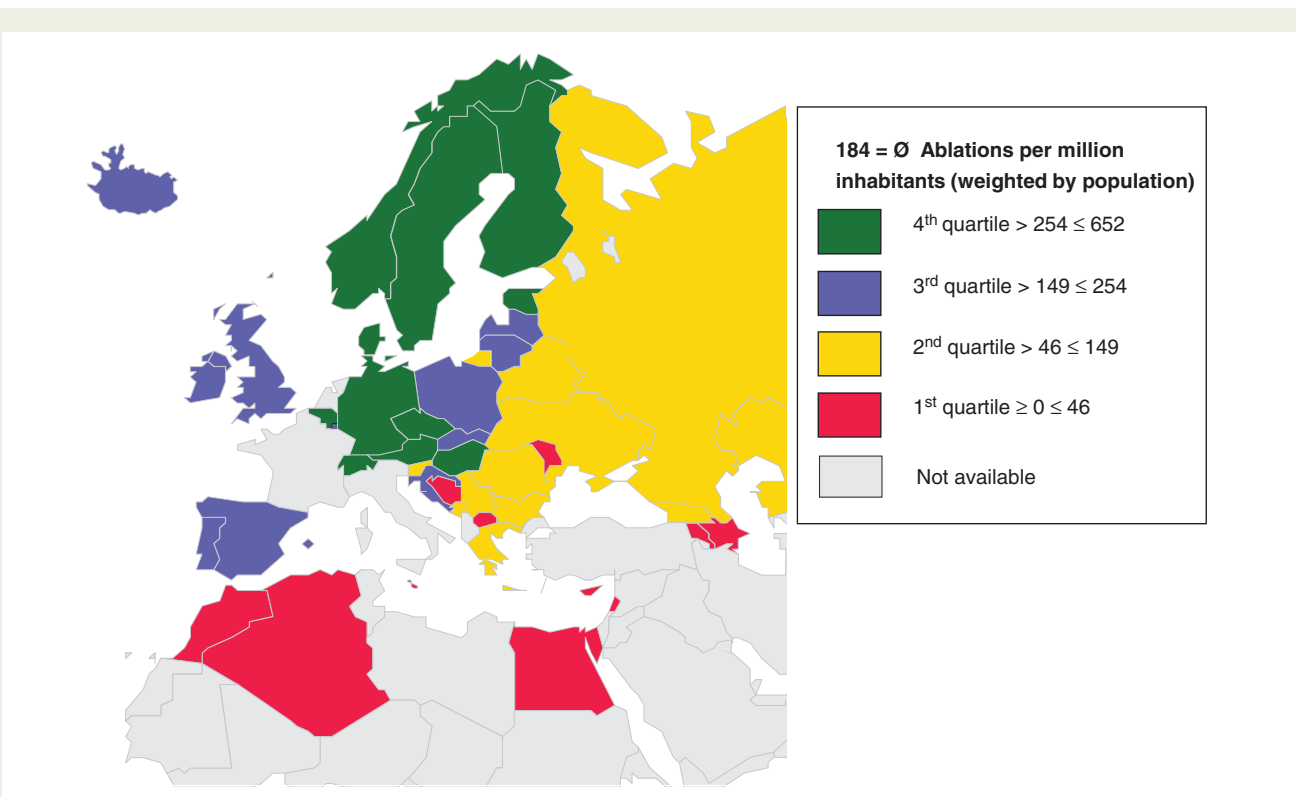


Figure 58 Catheter ablations in the European Society of Cardiology countries in 2013.

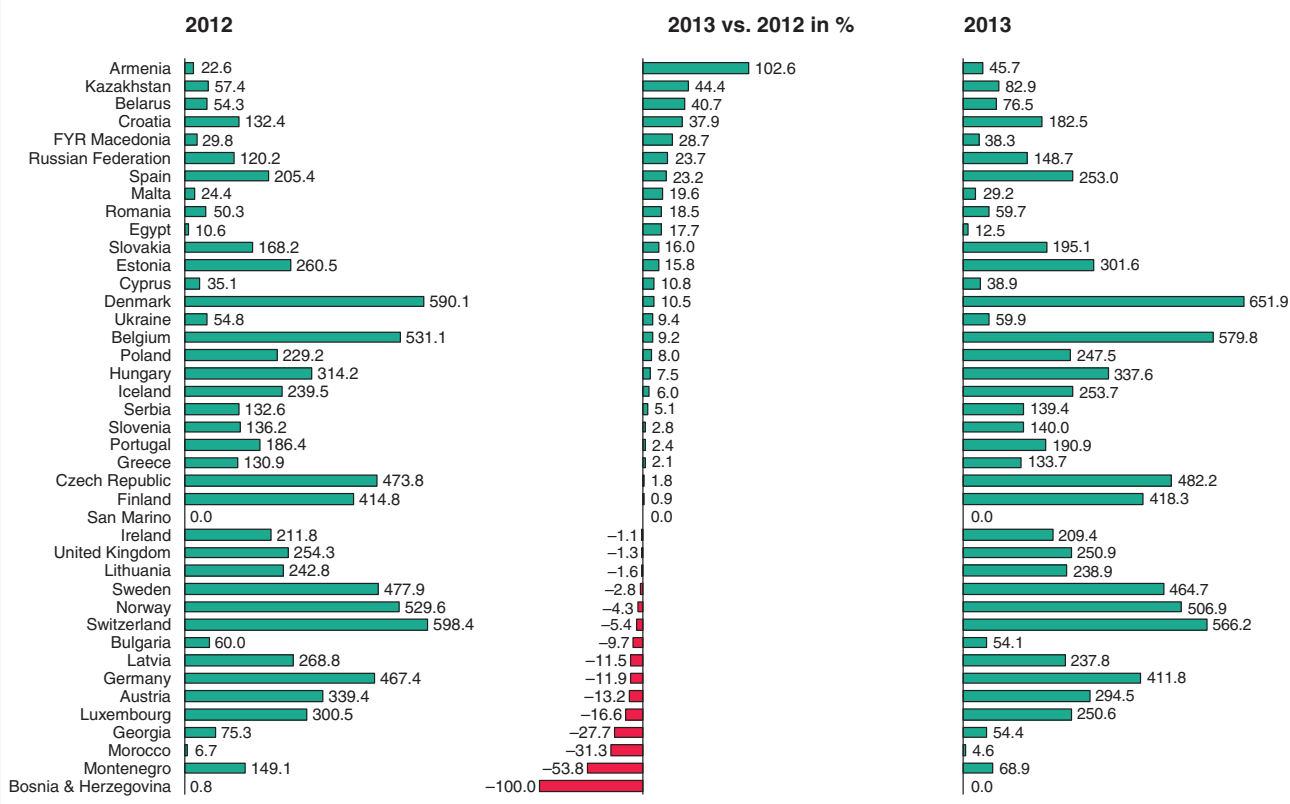


Figure 59 Change in the number of catheter ablations per million inhabitants from 2012 to 2013.

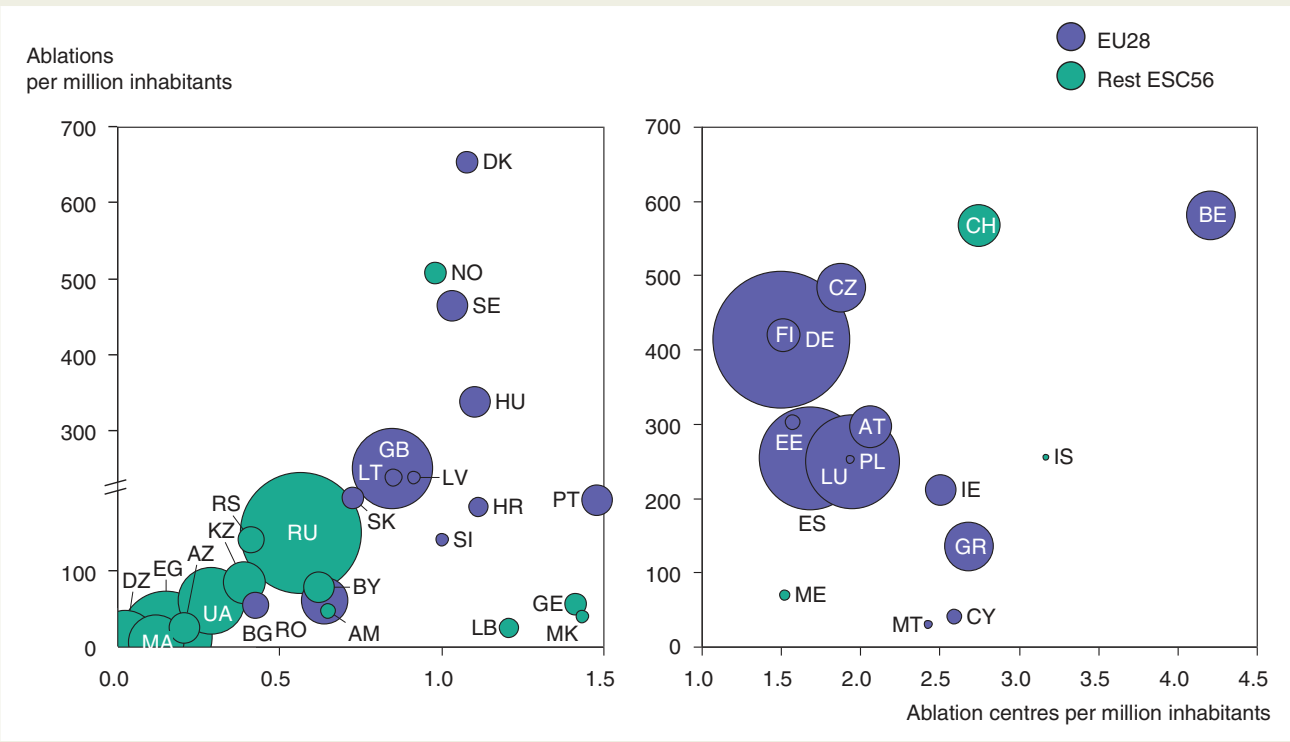
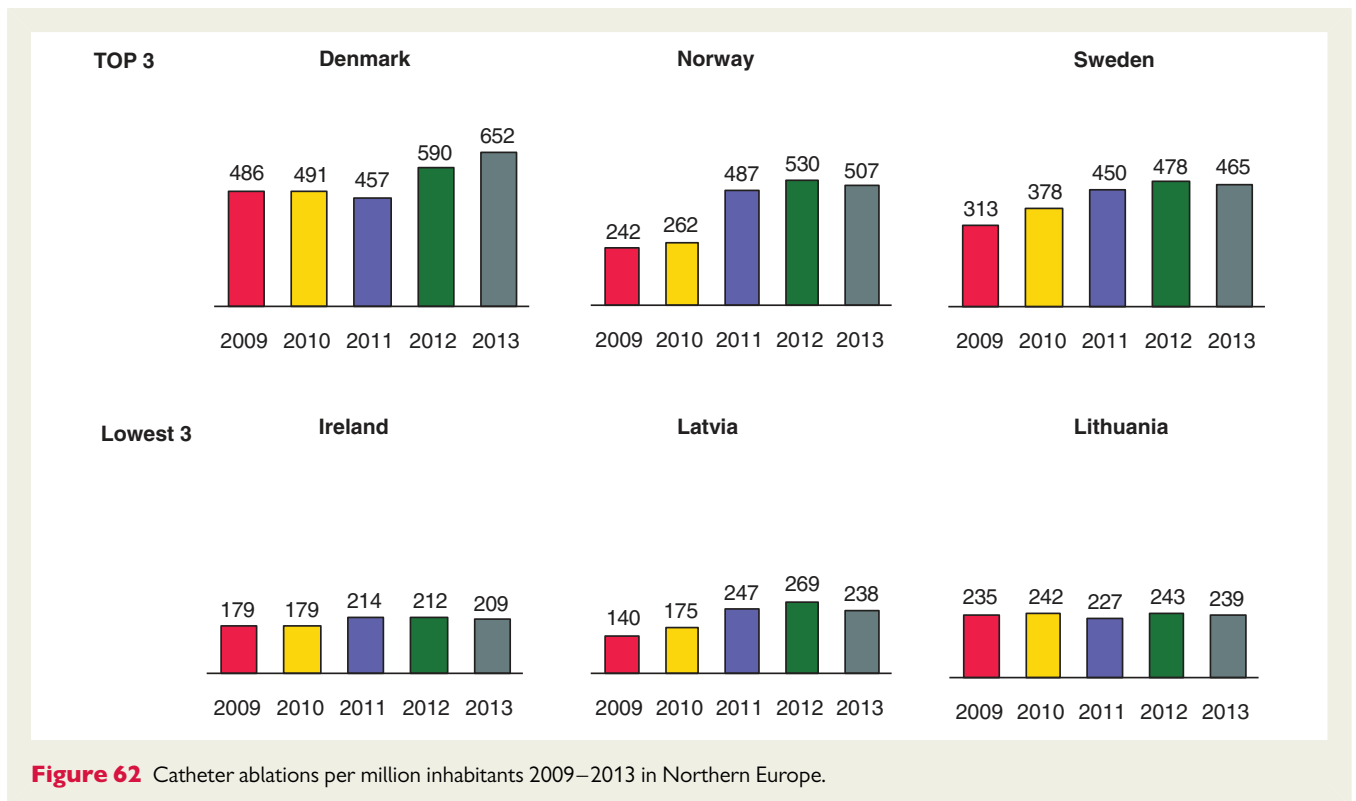
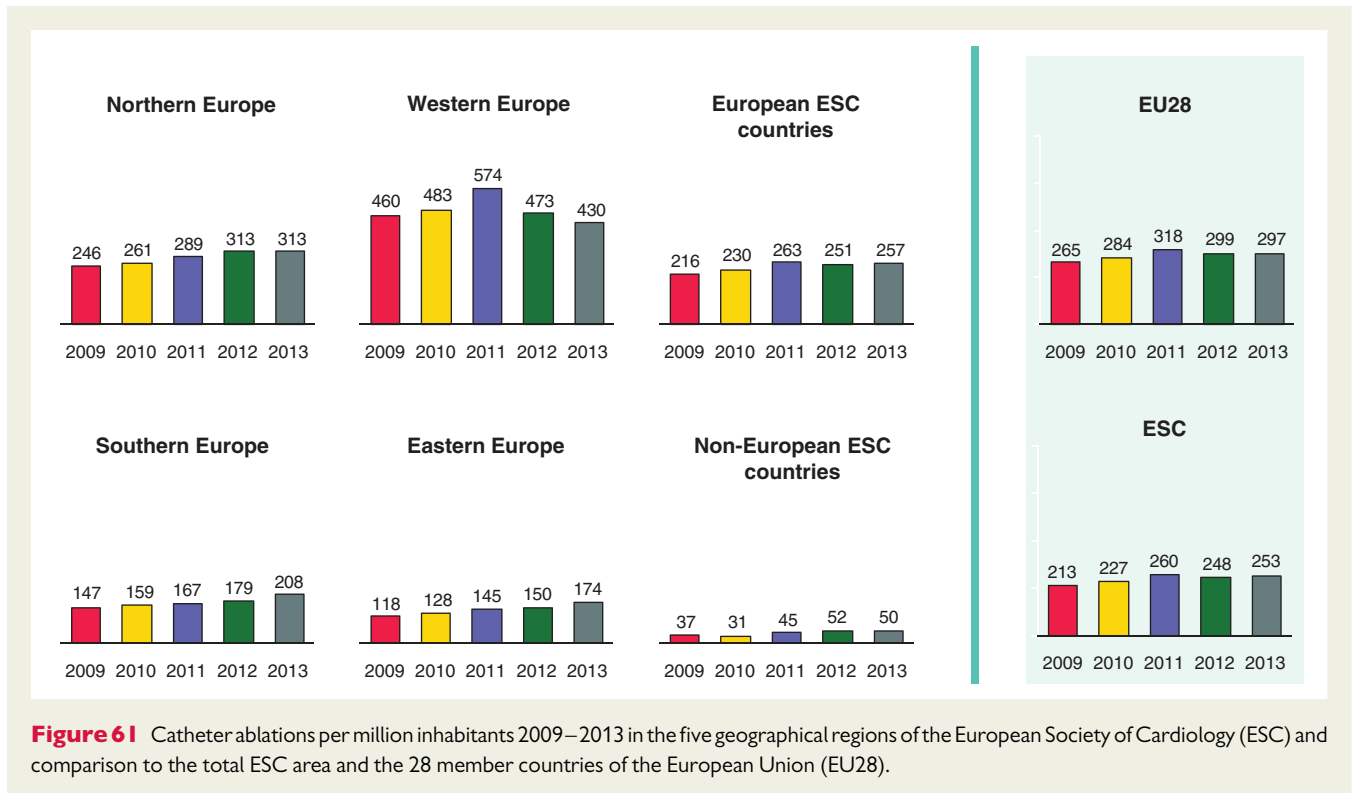


Figure 60 Catheter ablation centres and rates in the European Society of Cardiology (ESC) and European Union (EU28) member countries in 2013. Bubble size is related to population in the country.



Southern, and Eastern European region, and among non-European ESC countries were Norway (293 AF ablation per million population), Belgium (225), Slovenia (83), Czech Republic (196), and Kazakhstan, respectively (Figures 71, 72, 73, 74 and 75). The

ratio of AF ablation to the total number of ablation varied between 1.7% in Armenia to 59.1% in Slovenia. The proportion of AF ablations compared with all ablations was more than one-third in nine countries (Figure 76).

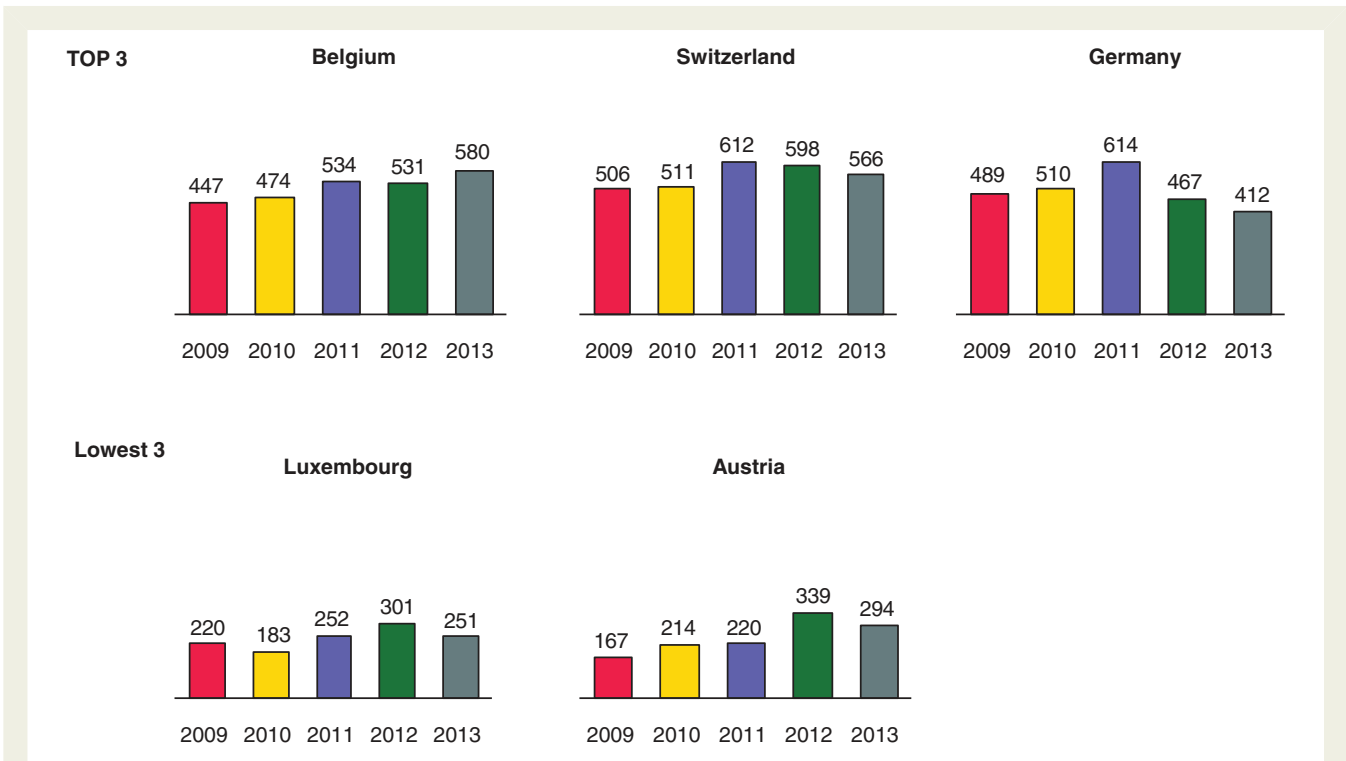


Figure 63 Catheter ablations per million inhabitants 2009–2013 in Western Europe. France and the Netherlands did not provide data on catheter ablations in 2013.

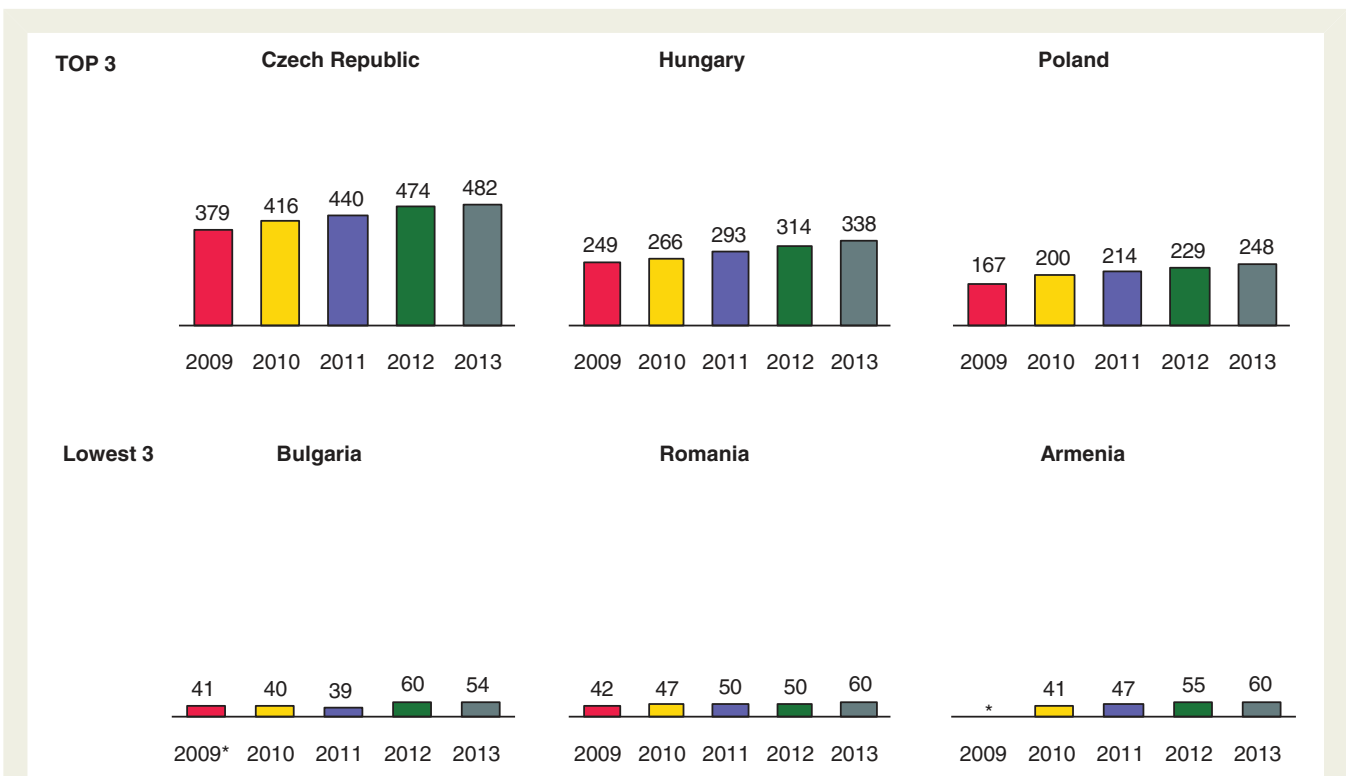


Figure 64 Catheter ablations per million inhabitants 2009–2013 in Eastern Europe. *No data available.

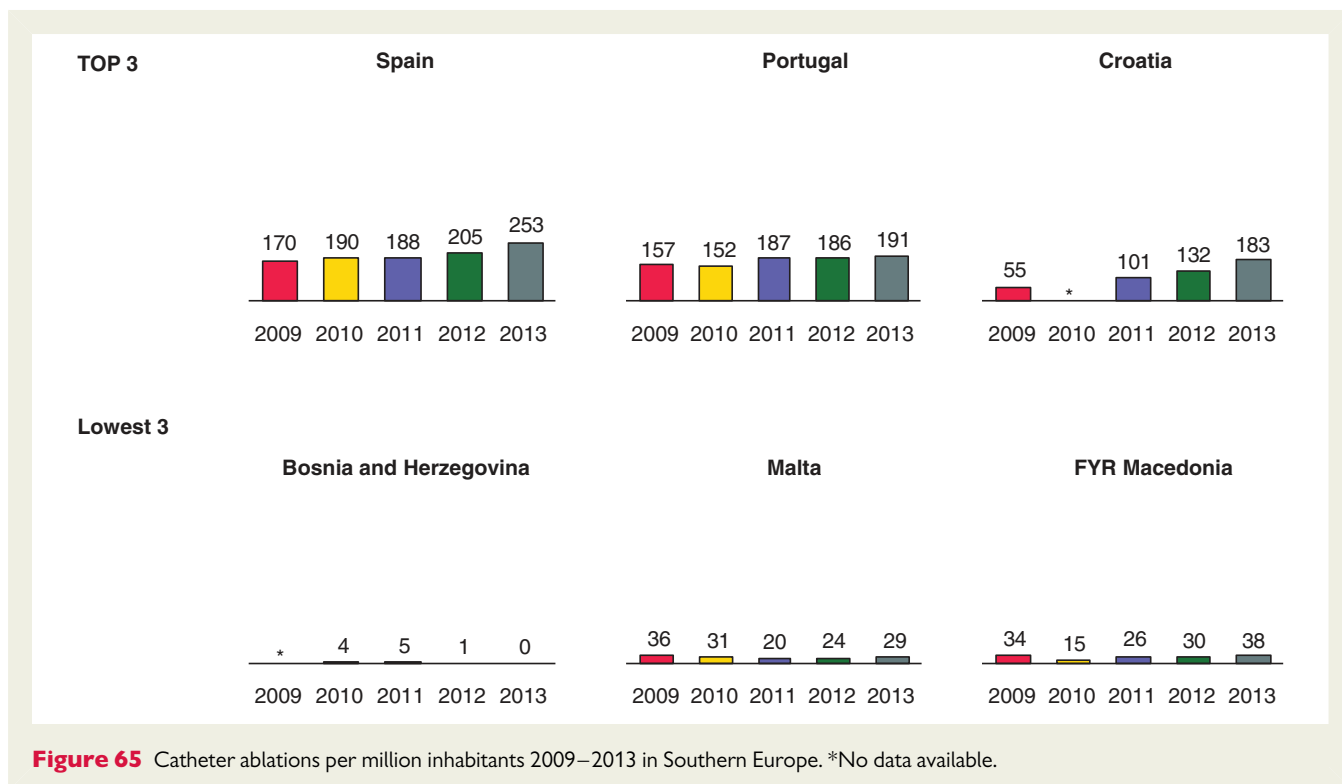


Figure 65 Catheter ablations per million inhabitants 2009–2013 in Southern Europe. *No data available.

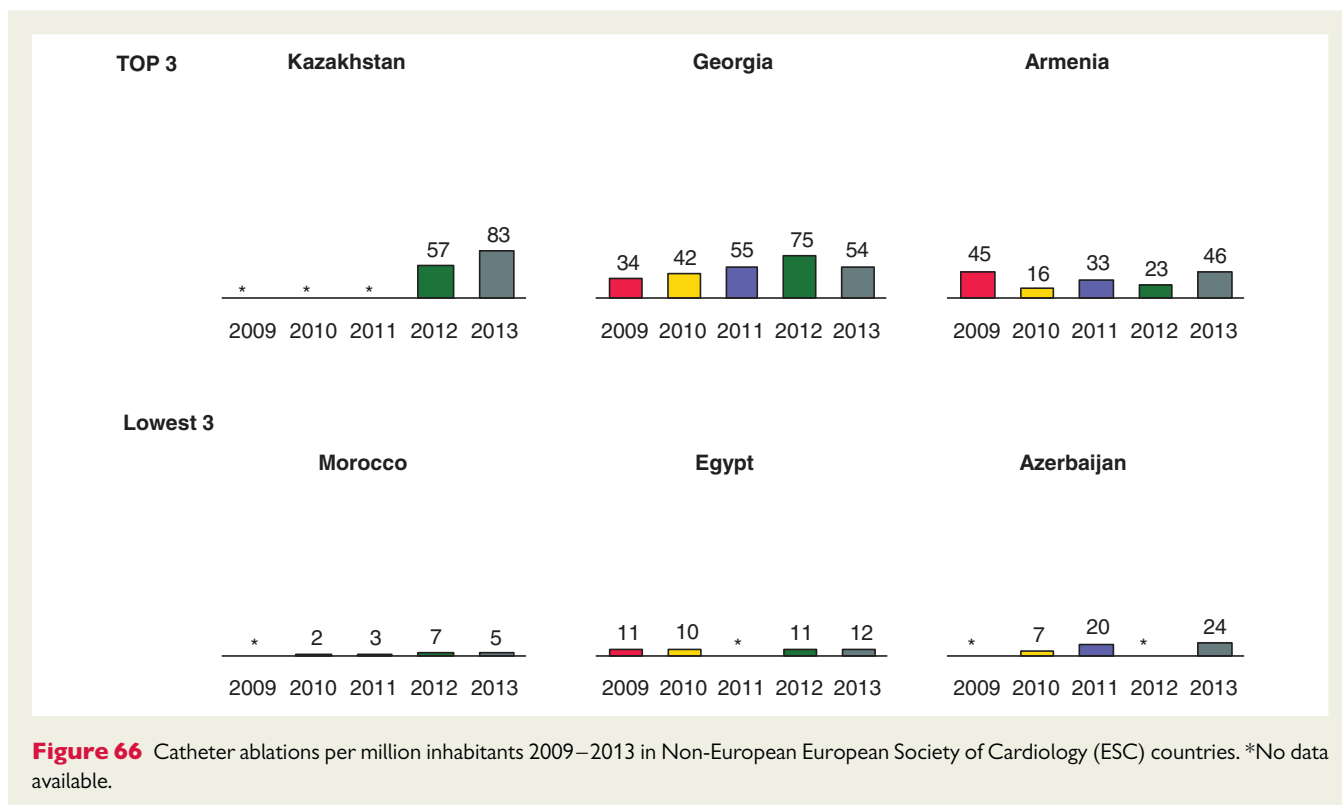


Figure 66 Catheter ablations per million inhabitants 2009–2013 in Non-European European Society of Cardiology (ESC) countries. *No data available.

It has been estimated that there is an urgent need to increase catheter ablation activity in patients with structural heart disease and ventricular tachyarrhythmias. In many countries, these procedures are undertaken in selected high-volume centres. In 2013 the number of

centres performing > 10 ventricular tachycardia (VT) ablations per million population was highest in Germany (1.0) and lowest in Ukraine (0.04) (Figure 77). To date no further data on the VT ablation numbers have been collected for the EHRA White Book.

Table 16 Atrial fibrillation ablations in 2013 with comparison to four previous years

Country	ISO code	AF Ablation procedures 2013		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 EU-28 level	2009	2010	2011	2012	2013
Albania ^a	AL	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Algeria	DZ	0	0	2044	3338	N/A	N/A	N/A	N/A	0
Armenia	AM	8	3	188	269	0	1	1	3	3
Austria	AT	771	94	–	–	36	54	62	122	94
Azerbaijan	AZ	4	0	534	840	N/A	0	0	N/A	0
Belarus	BY	70	7	560	843	3	6	4	6	7
Belgium	BE	2352	225	–	–	124	171	182	211	225
Bosnia & Herzegovina	BA	0	0	222	340	N/A	1	0	0	0
Bulgaria	BG	47	7	440	612	4	2	0	7	7
Croatia	HR	172	38	257	392	0	0	10	18	38
Cyprus	CY	6	5	47	101	0	0	3	5	5
Czech Republic	CZ	2082	196	–	–	116	N/A	156	177	196
Denmark	DK	1609	290	–	–	224	232	194	262	290
Egypt	EG	35	0	4571	7474	N/A	0	N/A	0	0
Estonia	EE	71	56	78	111	72	84	90	27	56
Finland	FI	654	124	–	–	65	73	91	110	124
France ^a	FR	N/A	N/A	N/A	N/A	99	118	100	130	N/A
Georgia	GE	35	7	256	433	1	10	9	11	7
Germany	DE	11 697	144	–	–	134	146	184	172	144
Greece	GR	430	40	654	944	18	22	32	37	40
Hungary	HU	859	86	–	871	50	49	61	75	86
Iceland	IS	23	73	–	28	38	41	48	77	73
Ireland	IE	450	94	–	–	78	78	96	95	94
Israel ^a	IL	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	N/A
Italy ^a	IT	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	N/A
Kazakhstan	KZ	268	15	977	1554	N/A	N/A	N/A	11	15
Kosovo ^a	XK	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Kyrgyzstan ^a	KGZ	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Latvia	LV	64	29	131	191	12	16	31	26	29
Lebanon ^a	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	30	9	194	308	19	22	19	8	9
Luxembourg	LU	31	60	–	45	41	24	54	61	60
FYR Macedonia	MK	0	0	118	183	0	0	0	0	0
Malta	MT	1	2	24	36	0	0	0	0	2
Moldova	MD	0	0	219	317	N/A	N/A	N/A	N/A	0
Montenegro	ME	0	0	37	57	0	0	0	0	0
Morocco ^a	MA	N/A	N/A	N/A	N/A	N/A	0	0	0	N/A
Netherlands ^a	NL	N/A	N/A	N/A	N/A	N/A	129	N/A	156	N/A
Norway	NO	1488	293	–	–	70	85	242	249	293
Poland	PL	1900	50	2211	3363	19	31	N/A	44	50
Portugal	PT	556	51	616	946	30	33	43	49	51
Romania	RO	120	6	1244	1909	0	1	3	4	6
Russian Federation	RU	5858	41	8225	12 487	18	21	27	27	41
San Marino	SM	0	0	2	3	0	0	0	0	0
Serbia	RS	120	17	424	635	10	7	8	14	17
Slovakia	SK	150	27	314	481	24	24	17	18	27

Continued

Table 16 Continued

Country	ISO code	AF Ablation procedures 2013		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 EU-28 level	2009	2010	2011	2012	2013
Slovenia	SI	165	83	–	175	46	44	59	55	83
Spain	ES	2201	46	2662	4151	22	N/A	31	33	46
Sweden	SE	1727	179	–	–	97	122	157	178	179
Switzerland	CH	1469	184	–	–	156	165	209	193	184
Syria ^a	SY	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tunisia ^a	TN	N/A	N/A	N/A	N/A	2	2	2	3	N/A
Turkey ^a	TR	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Ukraine	UA	680	15	2659	3906	N/A	N/A	11	14	15
United Kingdom	GB	5408	85	–	5555	62	60	74	80	85
Total ESC countries		43 611								

^aThese 12 countries did not submit data on atrial fibrillation ablation for the EHRA White Book 2014.

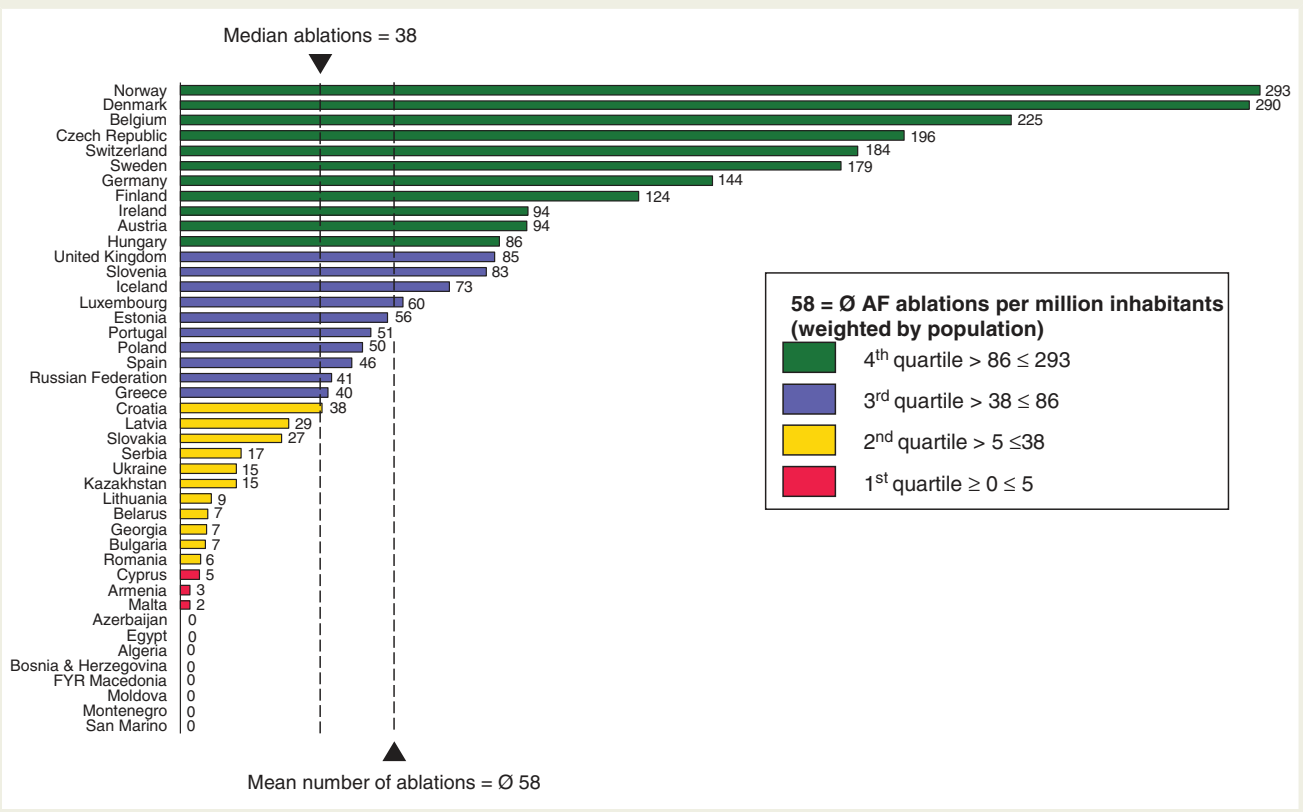


Figure 67 Atrial fibrillation ablations per million inhabitants in 2013.

Discussion

This comparative analysis of the EHRA White Book data show that considerable variations in use of invasive electrophysiological procedures still exist between the ESC member countries. While

several improvements have been made over a 5 year period from 2009 to 2013, there is still a clear need for improvement. 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. Catheter ablation

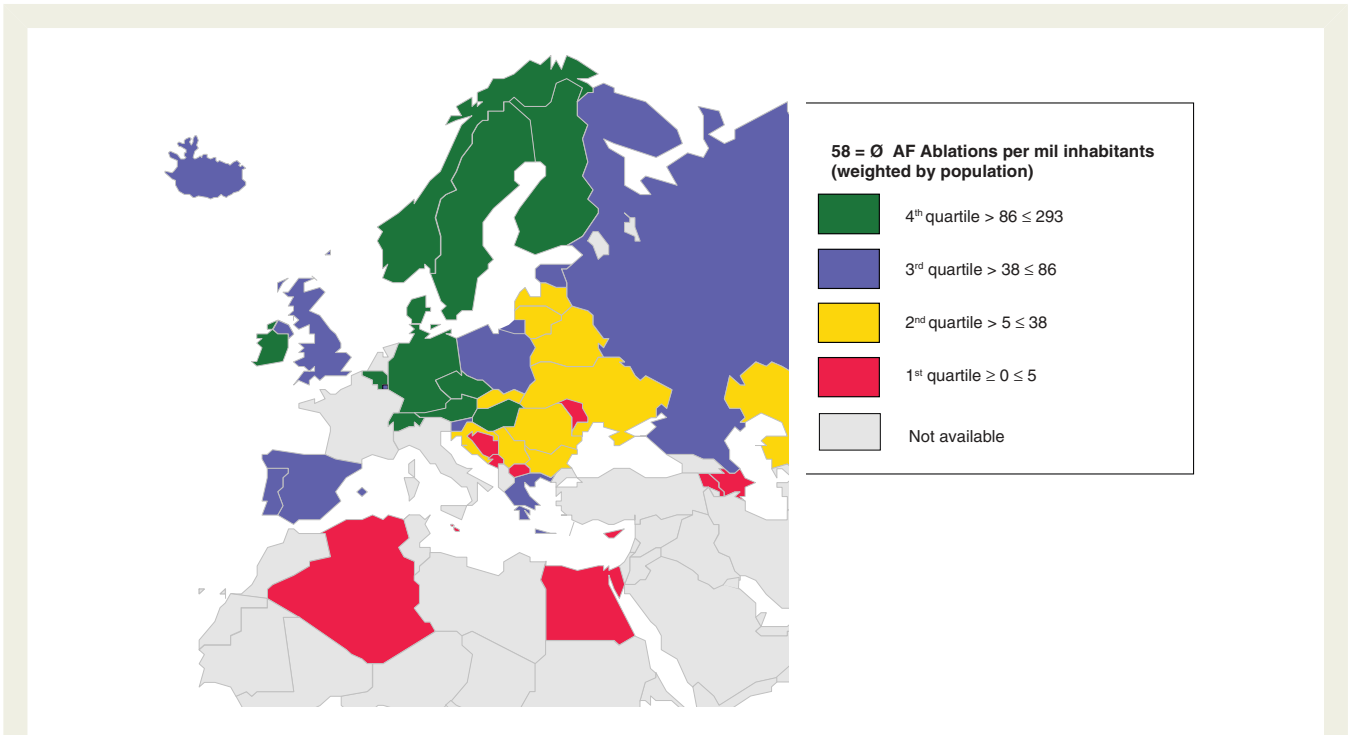


Figure 68 Atrial fibrillation (AF) ablations in the European Society of Cardiology countries in 2013.

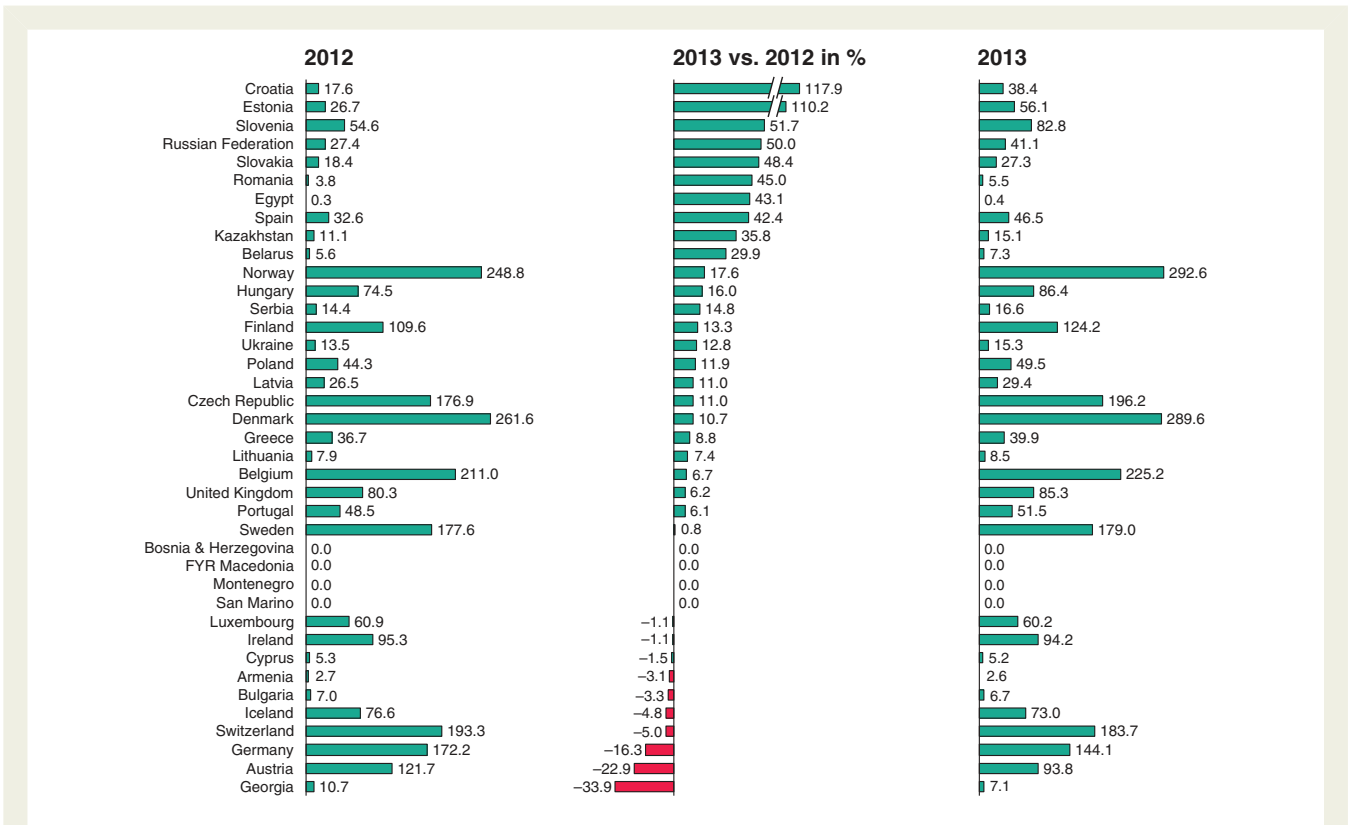


Figure 69 Change in the number of atrial fibrillation ablations per million inhabitants from 2012 to 2013.

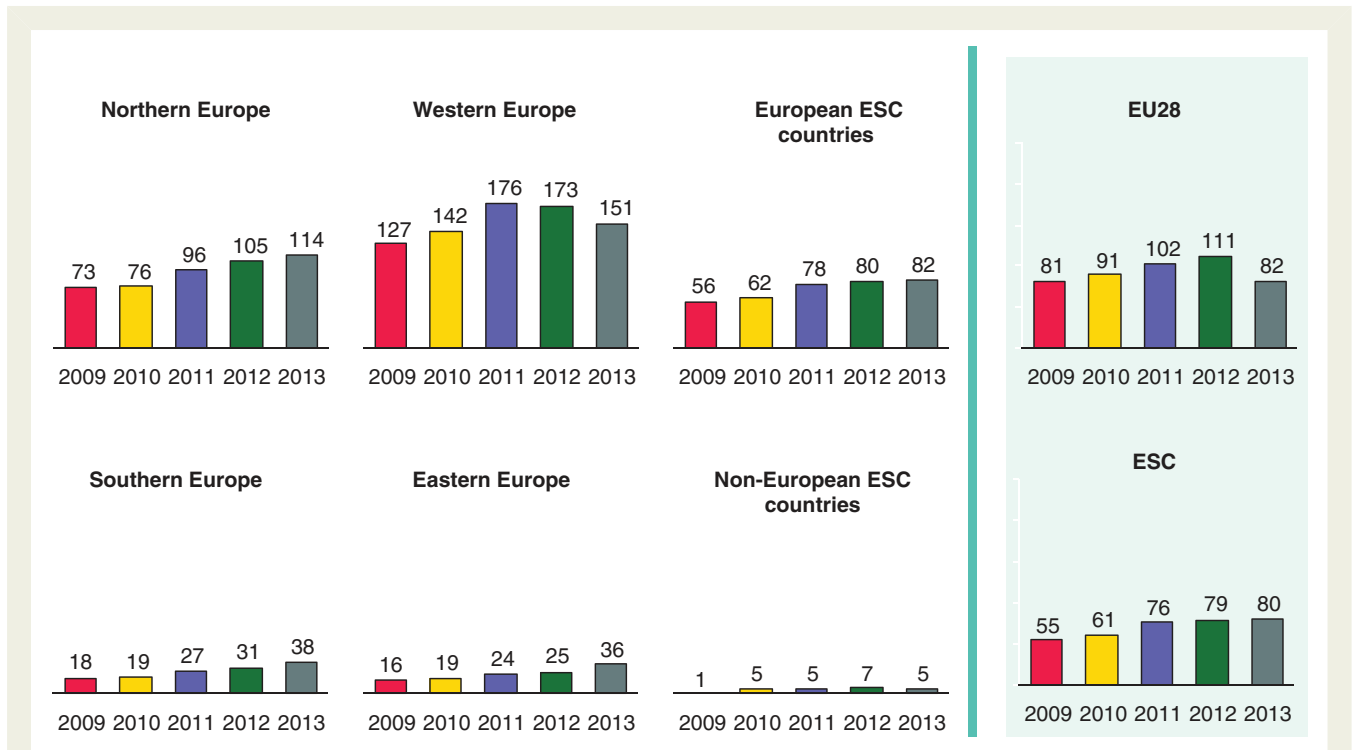


Figure 70 Atrial fibrillation (AF) ablations per million inhabitants 2009–2013 in the five geographical regions of the European Society of Cardiology (ESC) and comparison to the total ESC area and the 28 member countries of the European Union (EU28).

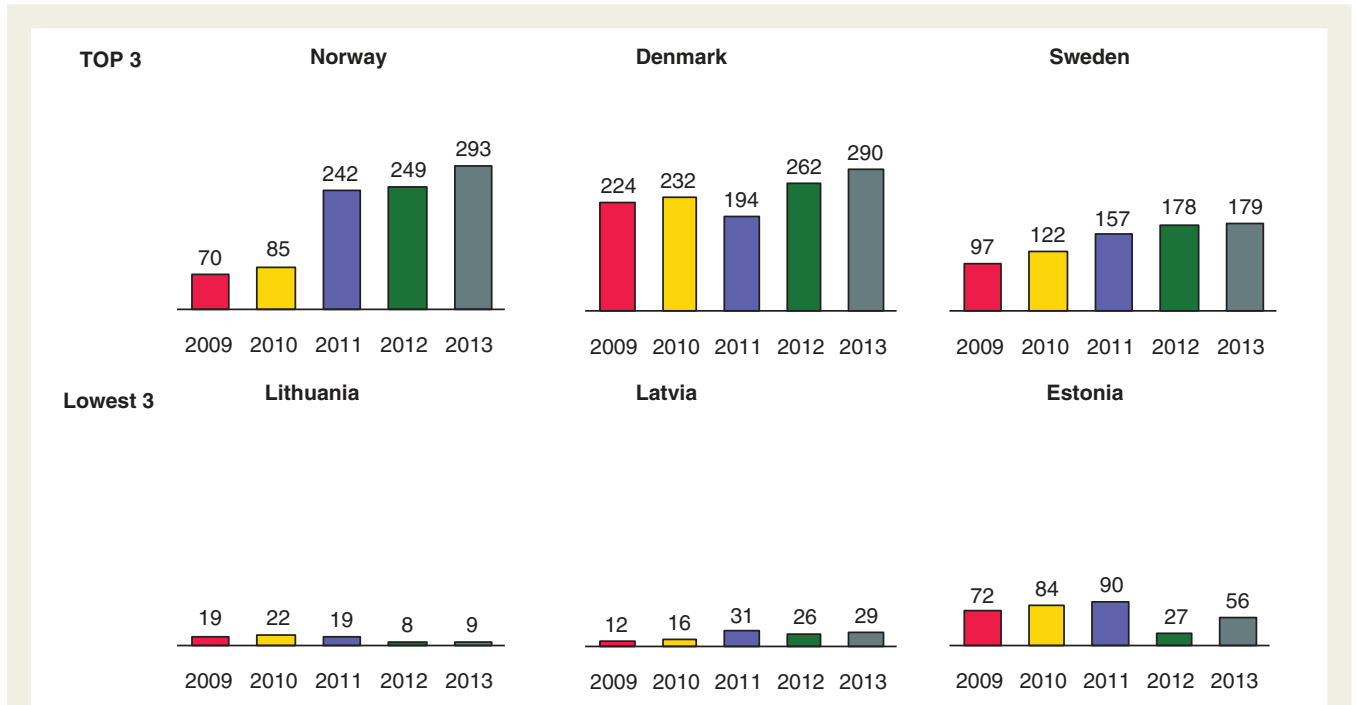


Figure 71 Atrial fibrillation ablations per million inhabitants 2009–2013 in Northern Europe.

activity was highest in the Western and Northern Europe and lowest in the non-European and Eastern European ESC countries. However, the Eastern European countries were

characterized by large variations in the procedure rates, with numbers spanning over the four quartiles of the activity distribution.

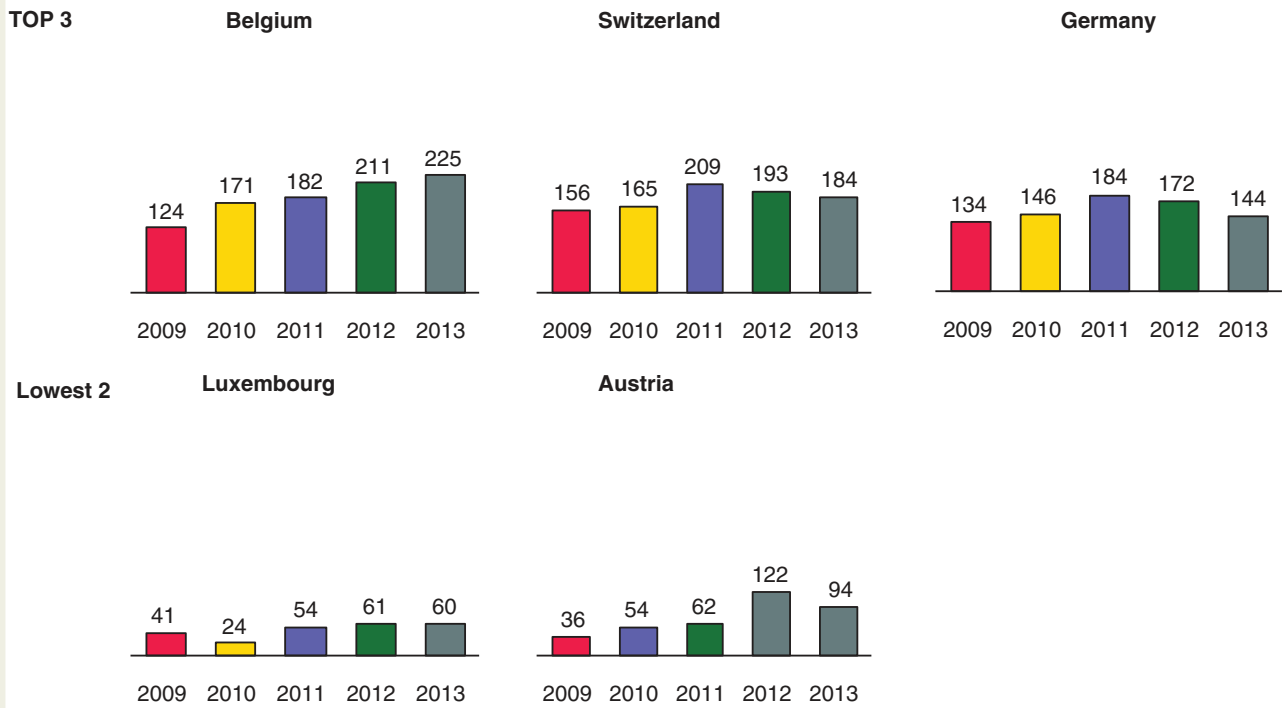


Figure 72 Atrial fibrillation ablations per million inhabitants 2009–2013 in Western Europe. France and the Netherlands did not provide data on AF ablations in 2013.

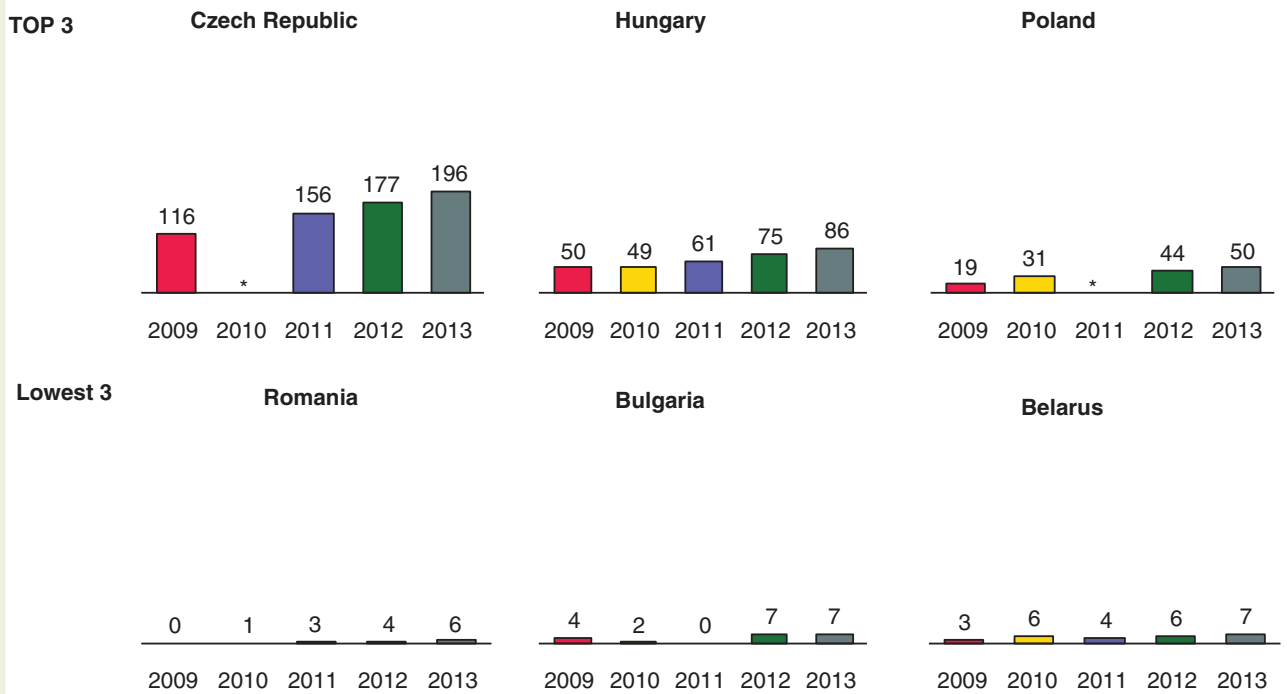


Figure 73 Atrial fibrillation ablations per million inhabitants 2009–2013 in Eastern Europe. *No data available.

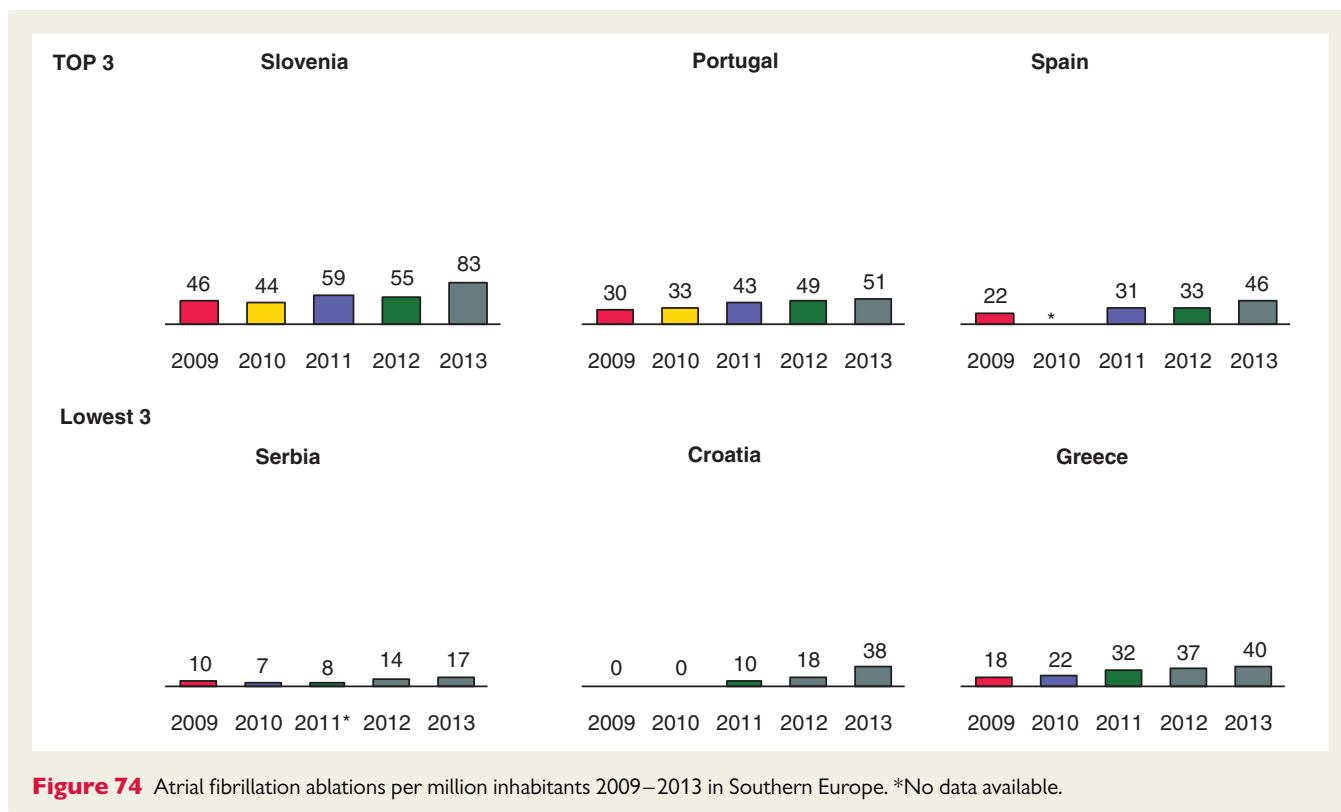


Figure 74 Atrial fibrillation ablations per million inhabitants 2009–2013 in Southern Europe. *No data available.

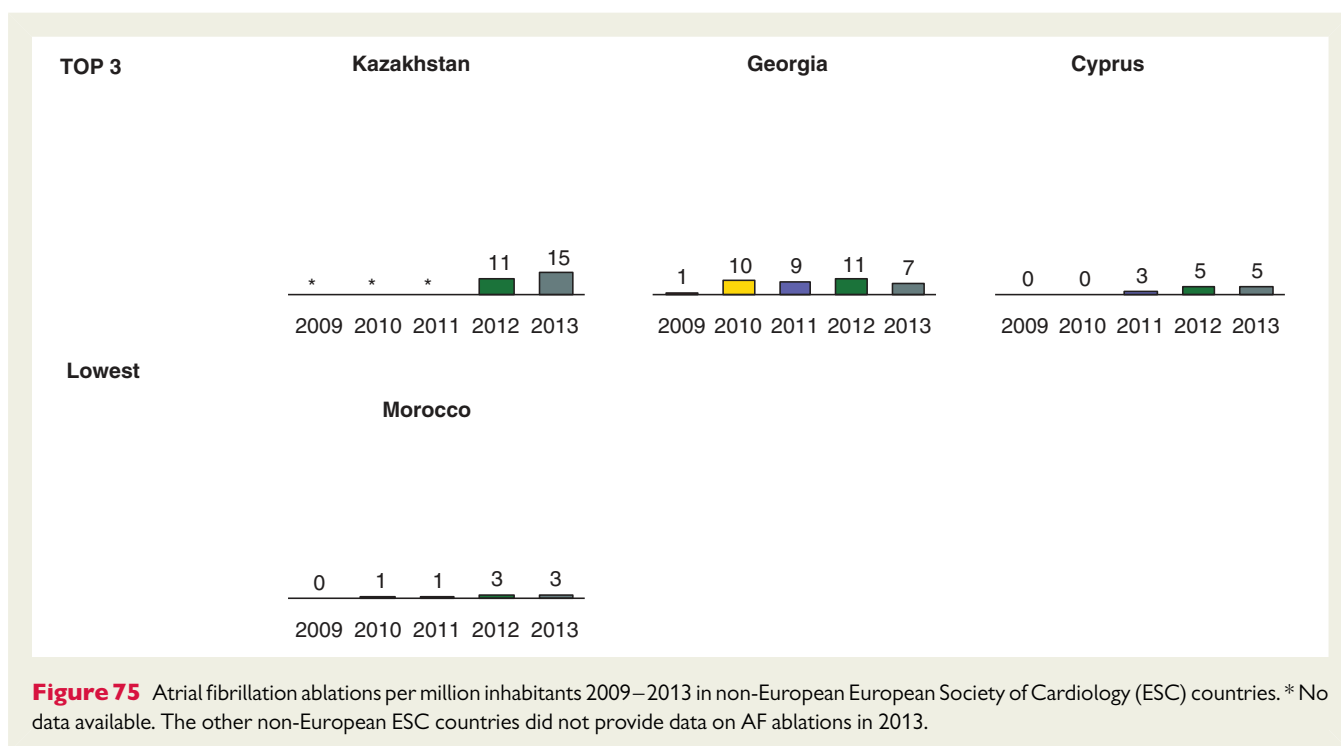


Figure 75 Atrial fibrillation ablations per million inhabitants 2009–2013 in non-European European Society of Cardiology (ESC) countries. * No data available. The other non-European ESC countries did not provide data on AF ablations in 2013.

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 reduced expenditure for healthcare is associated with a lower use of device therapy

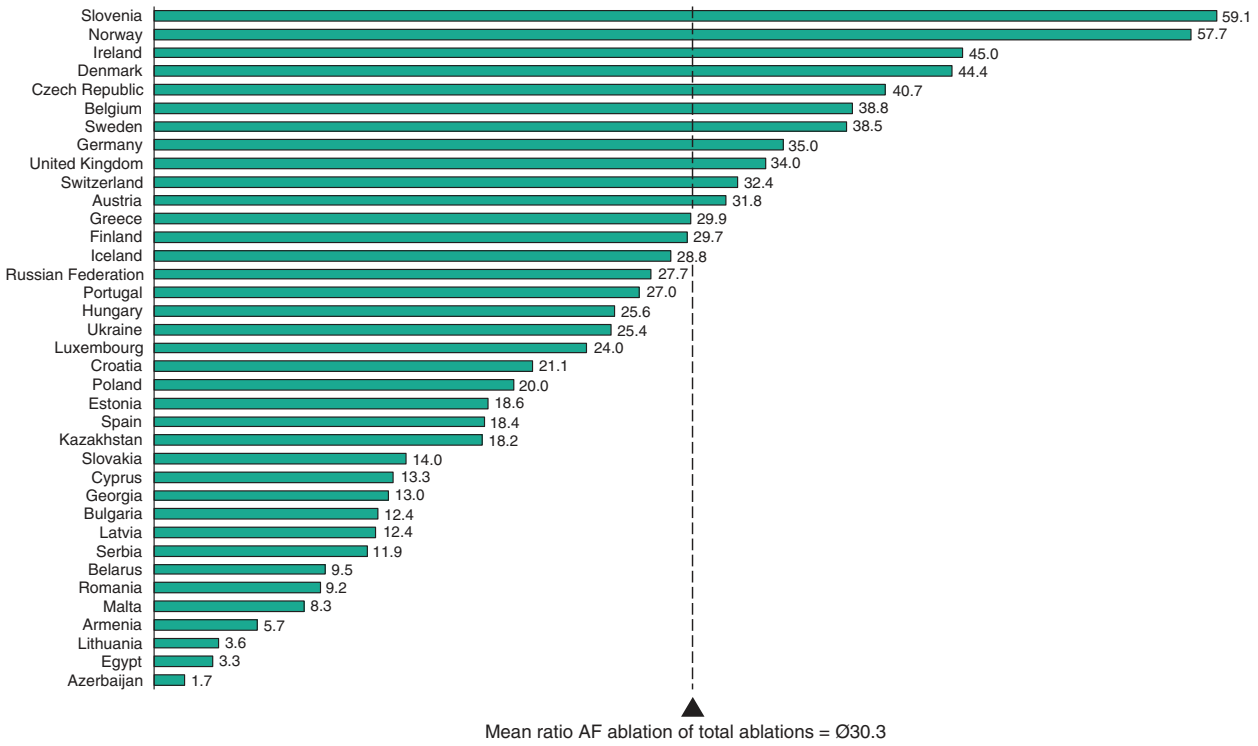


Figure 76 Proportion of atrial fibrillation ablations of total ablations in 2013.

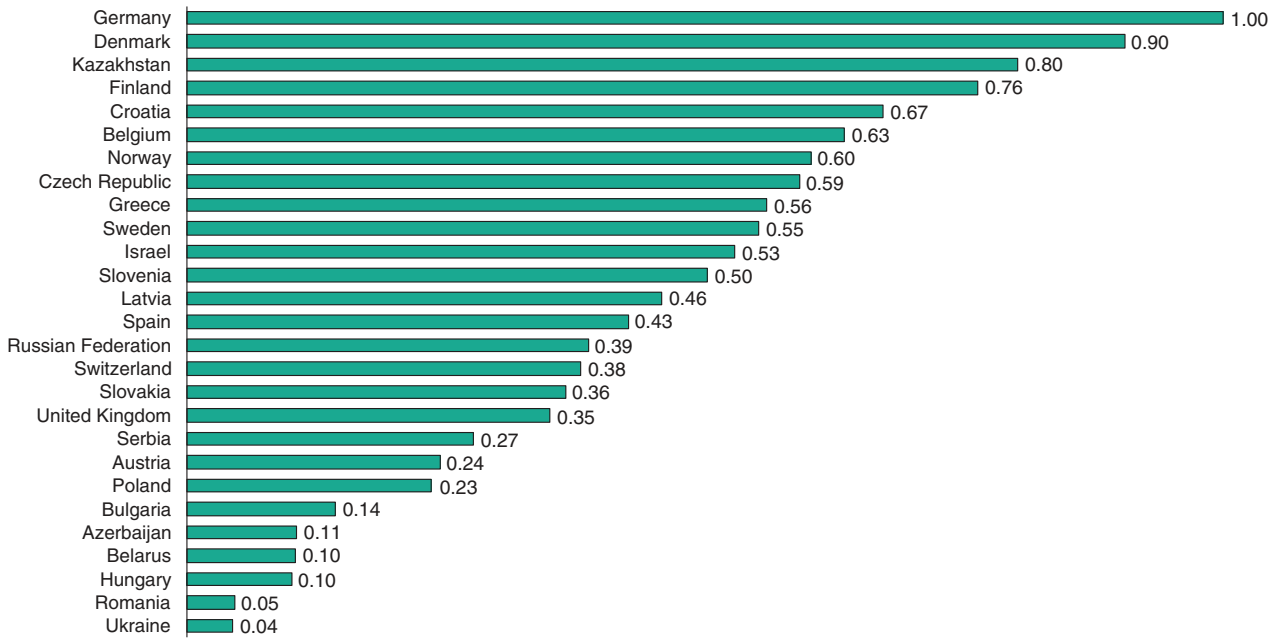
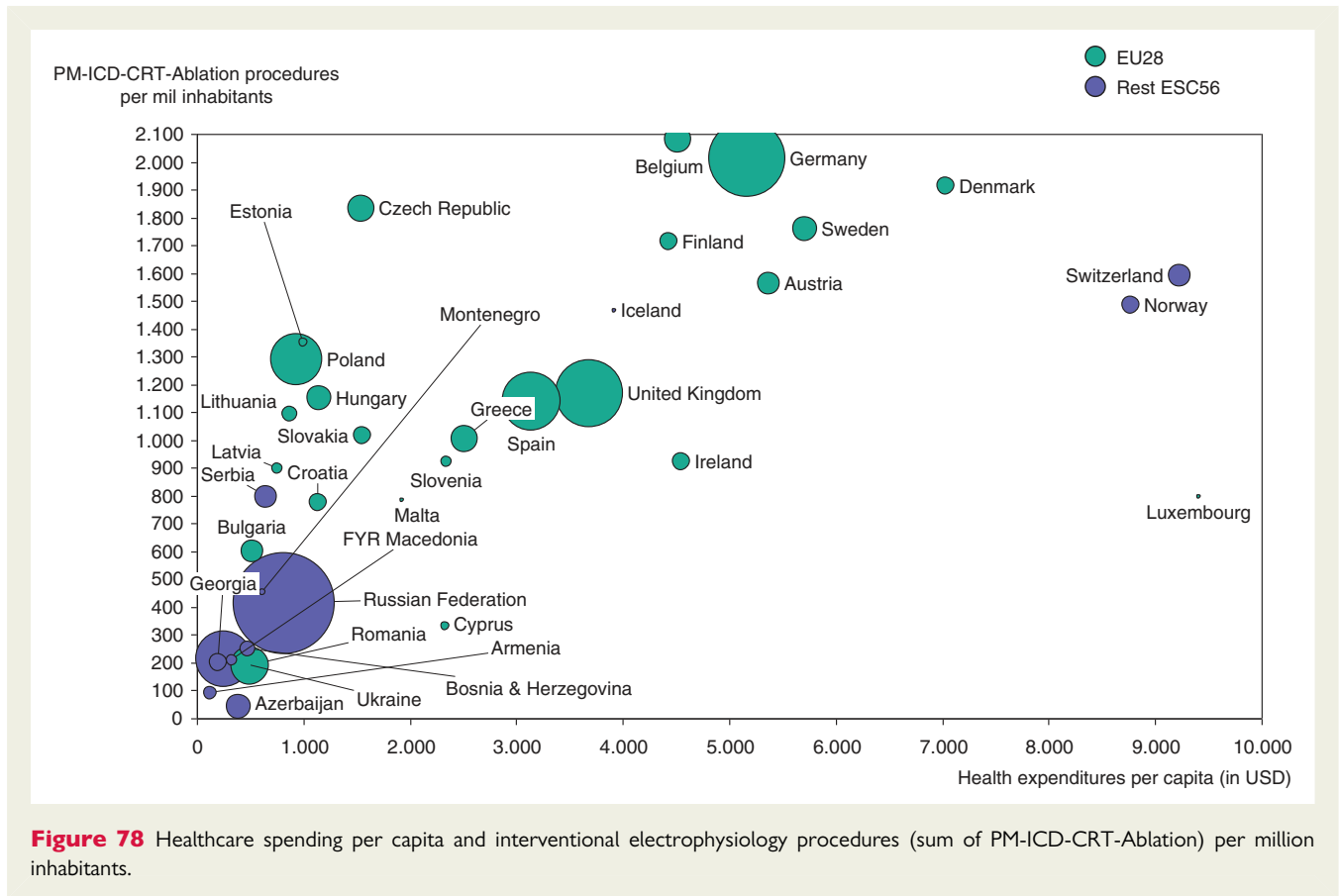


Figure 77 Number of centres which performed >10 ventricular tachycardia ablations per million inhabitants in patients with structural heart disease in 2013.



(Figure 78). However, in some Eastern European countries with low GDP, device implantation, and catheter ablation rates per million population exceed those of certain wealthy Western and Northern European countries. Furthermore, the number of hospitals and beds were not directly related to the financial profile or healthcare expenditure of a given country. This indicates that GDP is not the only driver for high or low utilization of complex therapies with a high upfront cost. Other potential explanations for the disparity include insufficient infrastructures and low referral rates. With regard to the potential for improvement, it is noteworthy that despite the ongoing economic difficulties across Europe, the use of device and catheter ablation therapies is consistently growing in a number of Eastern ESC countries. This is certainly a very positive trend. 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 constraints on healthcare expenditure or that supply is already having met demand.

The role of European Heart Rhythm Association

Disparities in the implementation of arrhythmia treatment is likely to continue, unless there is an investment in the required infrastructure and harmonization of training and implementation of standard clinical practice guidelines. 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 many discrepancies and provided an evidence base for the harmonization of cardiac rhythm management across ESC countries. The certification programme provides an excellent platform for EHRA's goal to improve training and the level of arrhythmia care in the ESC area. EHRA certification is acknowledged by more than half of the ESC countries and in some, it is now a mandatory requirement for practice. The introduction of the EHRA accreditation programme for teaching centres is expected to provide further support to harmonization of training requirements. EHRA fellowship grants have allowed many young physicians from emerging economies to be trained 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.

Limitations

There are several limitations in the methodology of the EHRA White Book data collection. Data collection is exclusively based on voluntary activity of the national working groups. Some countries have never reported data for the White Book and many countries report incomplete data. For example, in 2013 many countries did not provide data on LE. This may possibly reflect inaccuracies in the collection of data on these procedures, which are relatively new to many centres. With regard to the analysis and interpretation

of summary data, it was a major drawback that France, one of the most populated countries in ESC area, submitted an incomplete response. In addition, there were large variations in national data collection. About 50% of the data came from national registries (22 countries) and 50% were based on surveys and other estimates conducted by the national working groups. This is relevant since the 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. This is illustrated by the fact that in 2012 the average number of procedures undertaken per million population was 9% higher in countries without than in those with a national registry on catheter ablation (223 vs. 210 ablation per million population).¹⁴

This year the data were presented separately for five geographical regions within the ESC area. In order to avoid any economic, political, or historical bias the European regions were based on the United Nations Statistics Division and all other ESC countries were included in the non-European ESC region. This classification is not free of limitations. For example, Cyprus belongs to the Western Asia although it is a member of the European Union. 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

The longterm goal is to continuously improve the reliability and usefulness of the EHRA White Book data by increasing the quality and scope of the collected data. In this regard, it is our hope that the development of national registries and their coverage will improve in the future. The long-term goal is to set up an electronic database which would allow free comparisons both the ESC countries and within countries. Such a database would also provide a unique platform for online multinational registry-based clinical trials in arrhythmia therapy.¹⁵

Currently the main indications for catheter ablation are supraventricular tachycardias and atrial fibrillation. Recently, the use of catheter ablation for treatment of VT in patients with prior myocardial infarction and various cardiomyopathies has been increasing rapidly mainly due to expanding use of ICDs for both secondary and primary prevention of sudden cardiac death.¹⁶ In order to better understand the needs for VT ablations, we plan to collect more detailed data on VT ablations in the next EHRA White Book Survey.

Conclusions

The White Book data 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 high-quality information is critical 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 still is considerable heterogeneity in the availability of invasive arrhythmia therapies across the ESC area. Reducing this gap is one of the main objectives of EHRA.

Acknowledgements

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