



Regional variations in baseline characteristics of cardiac rhythm device recipients: The PANORAMA observational cohort study[☆]



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ABSTRACT

Background: The PANORAMA study was designed to collect concurrent data on subjects from different worldwide regions implanted with CRM devices.

Methods: In this prospective, multi-center study, we analyzed baseline data on 8586 subjects implanted with CRM devices with no additional selection criteria (66% pacemaker (IPG), 16% implantable cardiac defibrillators (ICD), 17% cardiac resynchronization therapy (CRT) and <1% Internal Loop Recorder) from 156 hospitals across 6 geographical regions between 2005 and 2011.

Results: Regardless of the device implanted, subjects from the Middle East and India often had more diabetes than other regions. Eastern and Western Europe had higher rates of atrial fibrillation reported, and men were more likely to smoke than women (46% vs 11%, $p < 0.001$). Within the CRT cohort there was significant variation in the proportion of males receiving a device, ranging from 55% in India to 83% in Eastern Europe.

Conclusions: We provide comprehensive descriptive data on patients receiving CRM devices from a range of geographies that are not typically reported in literature. We found significant variations in clinical characteristics and implant practices. Long term follow-up data will help evaluate if these variations require adjustments to outcome expectations.

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1. Introduction

Device therapies for treating cardiac rhythm disorders include pace-makers (IPG) and implantable cardiac defibrillators (ICD), both with

Abbreviations: ICD, implantable cardioverter-defibrillator; IPG, implantable pulse generator; CRT, cardiac resynchronization therapy; CRM, cardiac rhythm management; AV, atrio-ventricular; DFT, defibrillation threshold testing.

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and without cardiac resynchronization therapy (CRT). Randomized trials have established the effectiveness of device therapies for cardiac rhythm and disease management [1–5]. These trials have played an important role in establishing guidelines for the application of these therapies.

Translating evidence from randomized trials into global clinical practice guidelines involves extrapolating results from a study cohort to the population of interest in the guideline. However it is not a priori certain that study results from a specific patient population in a specific region can be extrapolated to a less well-defined patient population or to other geographies. Regional variations in disease incidence [6–8], patient demographics and comorbidities [9], genetics [10], health-care systems and reimbursement conditions [11], cultural attitudes to

disease and implant practices exist which affect the choice of therapy and may influence the expected therapy outcomes [12]. Risk factors can be considered and treated differently across geographies [13] and approaches to diagnostic testing can also differ. Understanding the patients, the practice patterns and the healthcare settings of a geography are important for setting expectations and interpreting patient outcomes.

While randomized trials are indispensable in understanding the benefit of therapies in strictly controlled settings, observational studies are designed to assess the relevance and credibility of clinical trial outcomes in real-life settings [14]. Our current understanding of the real world application of cardiac rhythm management (CRM) therapies comes largely from registries conducted in North America and Europe [15,16]. To date there is little evidence available to shed light on regional differences in practice patterns, particularly to understand demographics, comorbidities and treatment patterns in emerging geographies.

This is the first report of the world wide PANORAMA study, a long term, multi-center, prospective, non-randomized observational study. The primary purpose of the study was to construct a computerized database of national profiles and epidemiological data on patients wearing Medtronic implantable pacemakers, cardioverter defibrillators (both with and without cardiac resynchronization therapy), and implantable loop recorders. The study was conducted in 34 countries across 6 geographical regions. Minimal selection criteria ensured that the study population included elderly patients, patients with comorbidities and patients presenting for a replacement device in an effort to ensure that participants were representative of patients receiving therapy for cardiac rhythm disorders. The objective of this analysis is to describe the patients and implant procedures and to provide information on clinical characteristics in regions previously underrepresented.

2. Methods

2.1. Study population

Consenting patients included those who were implanted (either de novo device or replacement) with a Medtronic market-released CRM device (IPG or ICD with or without CRT capability); no other selection criteria were applied. The protocol specified that enrollment should take place within 30 days of the planned/performed implant procedure.

PANORAMA (ClinicalTrials.gov Identifier: NCT00382525) was designed and conducted in compliance with the local ethical considerations and according to the principles outlined in the 'World Medical Association Declaration of Helsinki' (October 2000) and the laws and regulations in the countries in which the study was conducted. The study was submitted to locally appointed ethics committees and informed consent was obtained from the subjects (or their guardians).

Patients were enrolled from 6 geographies: Latin America (Argentina, Bahamas, Brazil, Colombia, Dominican Republic, Ecuador, Mexico, Puerto Rico, Uruguay, Venezuela, and Virgin Islands), Western Europe (Austria, Belgium, Denmark, Spain, Germany, Greece, Luxemburg, Netherlands, and United Kingdom), Eastern Europe (Belarus, Czech Republic, Latvia, Lithuania, Poland, Romania, Russian Federation, Serbia, Slovakia, and Turkey), Middle East (Kuwait and Saudi Arabia), South Africa and India.

2.2. Study design

Patients were assessed at study entry and during follow-up visits for at least 1 year after implant. Patients were followed according to the standard follow-up visit scheme of the participating centers, and did not require any procedures beyond regular practice. All treatment decisions were at the discretion of the treating physician. PANORAMA was designed to enroll 10,000 patients.

2.3. Data collection and measures

Clinical data were collected by the investigators using an electronic case report form designed specifically for the study, and stored in a centralized database. The data collected at baseline included demographics and clinical characteristics, medical history, and cardiovascular pharmacological therapy. At implant, data were collected on the implantation procedure and techniques, adverse experiences and device programming.

The IPG cohort includes patients implanted with a single or dual chamber pacemaker. Indications were defined as: AV block (any form of atrioventricular conduction disorder), sinus node disease (any form of atrial based bradyarrhythmia) or other (neither of the previous two). The ICD cohort includes patients implanted with a single or dual chamber ICD. Indications were defined as: secondary prevention (survivor of prior sustained ventricular tachyarrhythmia) or primary prevention (risk factors for sudden cardiac arrest without prior episode). The CRT cohort includes patients implanted with a CRT-D or a CRT-P.

2.4. Statistics

Data are reported as mean \pm standard deviation (SD), median (interquartile range (IQR)) or as n (percentage). For continuous variables, comparisons across the regional groups were made using analysis of variance (ANOVA) with pairwise comparisons performed using Tukey's studentized range test. For categorical variables a chi-square test was used. All statistical analyses were performed using SAS software version 9.3 (SAS Institute). P values less than 0.05 were considered statistically significant. Stratification of the analysis was specified a priori by region, pathology, indication, and device type.

3. Results

A total of 10,064 subjects were enrolled in the PANORAMA study between 2005 and 2011. From the total study population 1478 patients were excluded from the database due to the lack of evidence of a signed Patient Informed Consent or Patient Data Release Form (1428), or because the same patient was, by mistake, created twice in the electronic database (50). This analysis includes data of the remaining 8586 subjects, all implanted with a CRM device, and enrolled by 156 centers across 34 countries. Two thirds of the study population was implanted with an IPG, 16% with ICD, 17% with CRT, and 1% were implanted with an implantable loop recorder or missing information about the device type. One third of the subjects were enrolled from Eastern Europe (EE), 17% from Western Europe (WE), 17% from South Africa (SA), 17% from the Middle East (ME), 13% from Latin America (LA) and 7% from India (IN) (Table 1).

Regardless of the type of device implanted, several cardiovascular risk factor patterns were noted to be similar. In particular, subjects from the Middle East had substantially more diabetes present than other regions (47% vs 20% EE, 19% LA, 15% SA, 25% WE, 33% IN, $p < 0.001$ for ME vs all); subjects from India were significantly lighter in weight (66 ± 13 kg vs 81 ± 16 EE, 71 ± 15 LA, 82 ± 20 SA, 79 ± 16 WE, 76 ± 19 ME, $p < 0.001$ for IN vs all) and in all regions men were more likely to smoke than females (46% vs 11%, $p < 0.001$).

There were also distinct differences in the amount of atrial fibrillation reported across the regions with Eastern and Western Europe reporting more atrial fibrillation than other regions (42% EE and 36% WE vs 15% LA, 15% ME, 26% SA, 9% IN, $p < 0.001$ for EE vs all and $p < 0.05$ for WE vs all).

The use of general anesthesia for all types of device implants was higher in Latin America than in other regions (26% vs 2% EE, 1% IN, 2% ME, 12% SA, 14% WE, $p < 0.001$ for LA vs all).

In the IPG cohort 46% were female and 41% were aged over or equal to 75 years of age. Table 2 reports the baseline and initial treatment characteristics of patients who received IPG therapy stratified by region.

Table 1
Overall baseline demographics and device characteristics by region.

Characteristics	Total n = 8586	Eastern Europe n = 2496	India n = 571	Latin America n = 1127	Middle East n = 1463	South Africa n = 1432	Western Europe n = 1497
Number of countries	34	10	1	11	2	1	9
Number of sites	156	34	9	34	5	13	61
Device (%)							
IPG	5592 (65)	1769 (71)	368 (64)	840 (75)	782 (53)	827 (58)	1006 (67)
ICD	1407 (16)	322 (13)	94 (16)	129 (11)	400 (27)	61 (4)	401 (27)
CRT	1455 (17)	400 (16)	108 (19)	116 (10)	276 (19)	469 (33)	86 (6)
Other ^a	132 (2)	5 (<1)	1 (<1)	42 (4)	5 (<1)	75 (5)	46 (1)

IPG = pacemaker; ICD = implantable cardiac defibrillator; CRT = cardiac resynchronization therapy; IQR = interquartile range.

^a Other includes implantable loop recorder (n = 76), missing (n = 56).

There were significant differences in median age across the regions ranging from 65 years in the Middle East and India to 76 years in Western Europe ($p < 0.001$), which remained even after adjusting for replacement device. AV block as a primary indication for implant was more common in India (77%), Latin America (62%) and the Middle East (72%) and least frequent in South Africa (26%) ($p < 0.001$). 22% of the IPG cohort was implanted with a single chamber device with the highest numbers in Latin America (25%), the Middle East (30%) and South Africa (31%) ($p < 0.001$). In 62% of the patients implanted with a single chamber device, persistent or permanent AF had not been reported.

Table 3 reports the baseline and initial treatment characteristics of patients who received ICD therapy stratified by region. The proportion of males was higher in the ICD cohort compared to the IPG cohort (82% vs 54%, $p < 0.001$) and ranged from 77% in South Africa and Latin America to 89% in India. Primary prevention as an indication for implant was highest in the Middle East (66%) and Western Europe (70%) and lowest in South Africa (25%) ($p < 0.001$). In all regions there was a small proportion of patients that had NYHA class II and QRS > 150 ms or NYHA III/IV and QRS > 120 ms with LVEF < 35% (Table 3). The use of a single chamber device was lowest in the Middle East (25%) and highest in Western Europe (92%) ($p < 0.001$). The use of defibrillation

Table 2
Baseline demographics, device and implant characteristics for the IPG cohort by region.

Characteristics	Total n = 5592 n (%)	Eastern Europe n = 1769 n (%)	India n = 368 n (%)	Latin America n = 840 n (%)	Middle East n = 782 n (%)	South Africa n = 827 n (%)	Western Europe n = 1006 n (%)
Median age, years (IQR)	72 (63,79)	73 (66,79)	65 (56,74)	74 (64,80)	65 (51,74)	72 (62,80)	76 (70,81)
Male	3030 (54)	884 (50)	236 (64)	431 (51)	406 (52)	461 (56)	612 (61)
Indication							
Sinus node dysfunction	2421 (43)	920 (52)	75 (20)	266 (32)	187 (24)	512 (62)	461 (46)
AV block	2733 (49)	686 (39)	283 (77)	529 (62)	561 (72)	218 (26)	465 (46)
Other ^a	431 (8)	161 (9)	10 (3)	54 (6)	34 (4)	95 (11)	77 (8)
Body mass index (kg/m ²)							
Mean (SD)	27 (5.3)	28 (4.7)	25 (4.4)	26 (4.4)	29 (6.9)	27 (5.8)	27 (4.5)
Overweight/obese ^b	2914 (52%)	1033 (58%)	170 (46%)	416 (50%)	522 (67%)	363 (44%)	410 (41%)
Previous or current smoker	1558 (28)	478 (27)	55 (15)	299 (36)	172 (22)	160 (19)	394 (39)
Hypertension	3418 (61)	1321 (75)	164 (45)	531 (63)	425 (54)	376 (46)	601 (60)
Diabetes	1258 (23)	379 (21)	118 (32)	166 (20)	292 (37)	109 (13)	194 (19)
Coronary artery disease	1256 (23)	441 (25)	133 (36)	103 (12)	156 (20)	206 (25)	217 (22)
Prior myocardial infarction	477 (9)	237 (13)	17 (5)	42 (5)	44 (6)	54 (7)	83 (8)
Coronary artery bypass grafting	340 (6)	93 (5)	30 (8)	25 (3)	48 (6)	91 (11)	53 (5)
Mean ejection fraction, % (SD)	57 (11.9)	55 (10.4)	54 (11.4)	59 (11.8)	54 (11.6)	59 (12.6)	61 (12.8)
NYHA							
I	742 (13)	369 (21)	26 (7)	122 (15)	50 (6)	35 (4)	140 (14)
II	1273 (23)	768 (43)	109 (30)	147 (18)	45 (6)	54 (7)	150 (15)
III	340 (6)	168 (10)	52 (14)	43 (5)	9 (1)	19 (2)	49 (5)
IV	44 (1)	11 (1)	3 (1)	4 (1)	3 (<1)	18 (2)	5 (1)
No heart failure	3175 (57)	451 (26)	178 (48)	523 (62)	674 (86)	700 (85)	650 (65)
Atrial fibrillation							
Paroxysmal	1093 (20)	586 (33)	33 (9)	69 (8)	57 (7)	83 (10)	265 (26)
Persistent/permanent	847 (11)	226 (13)	5 (1)	75 (9)	73 (9)	133 (16)	115 (11)
CHADS2 score 2 or more	2960 (53)	1192 (67)	170 (46)	438 (52)	326 (42)	287 (35)	547 (54)
Single chamber device	1236 (22)	363 (21)	57 (16)	210 (25)	233 (30)	252 (31)	121 (12)
Specialization of implanting physician ^c							
Electrophysiologist	2122 (38)	436 (25)	363 (99)	385 (46)	741 (95)	124 (15)	73 (7)
Cardiologist	2516 (45)	765 (43)	3 (1)	237 (28)	9 (1)	702 (85)	800 (80)
Surgeon	919 (16)	565 (32)	2 (1)	211 (25)	15 (2)	0 (0)	126 (13)
EP or cardiac catheter lab implant setting	4212 (75)	1199 (68)	364 (99)	617 (74)	763 (98)	812 (98)	457 (45)
General anesthesia	372 (7)	7 (<1)	4 (1)	178 (21)	24 (3)	59 (7)	100 (10)

IPG = implantable pulse generator; EP = electrophysiology; IQR = interquartile range; SD = standard deviation.

^a Other includes syncope, (bradycardia due to) atrial fibrillation and supraventricular arrhythmia.

^b Overweight defined as BMI (kg/m²) between 25 and 29 and obese defined as BMI > 30.

^c Specialization of physician was self-reported.

Table 3
Baseline demographics, device and implant characteristics for ICD cohort by region.

Characteristics	Total n = 1407 n (%)	Eastern Europe n = 322 n (%)	India n = 94 n (%)	Latin America n = 129 n (%)	Middle East n = 400 n (%)	South Africa n = 61 n (%)	Western Europe n = 401 n (%)
Median age, years (IQR)	61 (52,70)	60 (52,68)	56 (48,66)	64 (54,73)	58 (48,67)	58 (44,66)	67 (58,73)
Male	1149 (82)	261 (81)	84 (90)	99 (77)	330 (83)	47 (77)	328 (82)
Indication for ICD							
Secondary prevention ^a	643 (46)	216 (67)	64 (68)	60 (47)	137 (34)	46 (75)	120 (30)
Primary prevention	764 (54)	106 (33)	30 (32)	69 (54)	263 (66)	15 (25)	281 (70)
Body mass index (kg/m ²)							
Mean (SD)	28 (5.6)	28 (5.2)	25 (4.0)	27 (5.0)	29 (6.3)	28 (6.0)	28 (5.2)
Overweight/obese ^b	865 (61%)	196 (61%)	32 (34%)	79 (61%)	295 (74%)	30 (49%)	233 (58%)
Previous or current smoker	699 (50)	168 (52)	18 (19)	53 (41)	220 (55)	24 (39)	216 (54)
Hypertension	774 (55)	195 (61)	21 (22)	63 (49)	236 (59)	25 (41)	234 (58)
Diabetes	481 (34)	49 (15)	29 (31)	26 (20)	227 (57)	3 (5)	147 (37)
Coronary artery disease	944 (67)	208 (65)	57 (61)	72 (56)	284 (71)	34 (56)	289 (72)
Prior myocardial infarction	609 (43)	154 (48)	25 (27)	42 (33)	166 (42)	18 (30)	204 (51)
Coronary artery bypass grafting	273 (19)	54 (17)	23 (25)	14 (11)	64 (16)	12 (20)	106 (26)
Mean ejection fraction, % (SD)	34 (13.3)	40 (14.3)	34 (14.8)	34 (15.0)	31 (10.9)	43 (15.7)	31 (11.2)
NYHA							
I	232 (17)	48 (15)	9 (10)	25 (20)	111 (28)	8 (13)	31 (8)
II	594 (42)	138 (43)	46 (49)	45 (35)	164 (41)	9 (15)	192 (48)
III	313 (22)	97 (30)	14 (15)	27 (21)	35 (9)	7 (12)	133 (33)
IV	27 (2)	3 (1)	1 (1)	3 (2)	2 (1)	4 (7)	14 (4)
No heart failure	236 (17)	35 (11)	24 (26)	29 (23)	88 (22)	33 (54)	27 (7)
QRS duration > 120 ms	285 (20)	93 (29)	17 (18)	31 (24)	66 (17)	12 (20)	66 (17)
CRT indication ^c	95 (7)	33 (10)	5 (5)	8 (6)	13 (3)	4 (7)	32 (8)
Atrial fibrillation							
Paroxysmal	117 (8)	51 (16)	3 (3)	5 (4)	20 (5)	4 (7)	34 (9)
Persistent/permanent	162 (12)	49 (15)	2 (2)	5 (4)	16 (4)	1 (2)	89 (22)
CHADS2 score 2 or more	830 (59)	190 (59)	33 (35)	66 (51)	242 (61)	15 (25)	284 (71)
Single chamber device	804 (57)	179 (56)	73 (78)	40 (31)	98 (25)	44 (72)	370 (92)
Specialization of implanting physician ^d							
Electrophysiologist	761 (54)	129 (40)	94 (100)	67 (52)	376 (94)	40 (66)	55 (14)
Cardiologist	417 (30)	42 (13)	0 (0)	38 (30)	0 (0)	21 (34)	316 (79)
Surgeon	206 (15)	150 (47)	0 (0)	24 (19)	2 (1)	0 (0)	30 (8)
EP or cardiac catheter lab implant setting	975 (69)	154 (48)	94 (100)	97 (75)	395 (99)	61 (100)	174 (43)
Anesthesia							
General anesthesia	224 (16)	38 (12)	0 (0)	60 (47)	4 (1)	32 (53)	90 (22)
Defibrillation testing performed	806 (57)	193 (60)	67 (71)	97 (75)	139 (35)	54 (89)	256 (64)

ICD = implantable cardioverter defibrillator; EP = electrophysiology; IQR = interquartile range; SD = standard deviation.

^a Secondary prevention indication includes: cardiac arrest (presumably) due to VT or VF, spontaneous sustained VT or VF with structural heart disease (symptomatic and non-symptomatic), unexplained syncope with structural heart disease, unexplained syncope with (depressed EF and) inducible VT/VF.

^b Overweight defined as BMI (kg/m²) between 25 and 29 and obese defined as BMI > 30.

^c CRT indication defined as LVEF < 35% with NYHA class II and QRS > 150 ms or NYHA III/IV and QRS > 120 ms.

^d Specialization of physician was self-reported.

threshold testing (DFT) at implant varied between regions from 35% in the Middle East to 89% in South Africa. There was no difference in age or gender when comparing patients who received defibrillation testing to those who did not receive defibrillation testing. A decline in the proportion of patients receiving defibrillation testing over time (2005–2007 66% vs 2008–2009 62% vs 2010–2011 48%, *p* for trend = 0.001) was seen.

The CRT cohort was of similar age with the ICD cohort and younger than the IPG cohort (63 years vs 61 (ICD) and 72 (IPG)). Table 4 reports the baseline and initial treatment characteristics of patients who received CRT therapy stratified by region. Notable differences between regions in subject demographics include male gender ranging from 55% in India to 83% in Eastern Europe, and median age ranging from 58 years in India to 73 years in Western Europe. Regional variation in the use of CRT-D vs CRT-P was considerable with 85% of the CRT devices implanted in the Middle East having defibrillator functionality compared to only 12% in South Africa. 20% of the CRT-D cohort was female compared to 33% of the CRT-P cohort, *p* < 0.001. In those that had QRS data available, less than half of the CRT recipients in South Africa, had a QRS > 120 ms. 50% of the patients had the LV lead implanted in the posterolateral location, but in a significant percentage of patients in Eastern Europe and Latin America, the LV lead was implanted in the middle lateral vein location. The use of defibrillation threshold testing (DFT) for CRT-D device implants varied between regions from 7% in South Africa to 30% in Latin America.

4. Discussion

The PANORAMA database provides unprecedented observational data collected from more than 8500 subjects being treated for cardiac rhythm disturbances from diverse geographies, facilitating comparisons and examination of patient demographics, disease comorbidities, and implant practices. Despite some difficulties associated with conducting research outside of the usual western settings, the importance of including such subjects should not be underestimated; majority of RCT data for cardiac rhythm disturbances are based on North American (US) patients. However, when looking to the worldwide implanted CRM devices, the US population receives only about 20% of the total number of pacemakers and 40% of the total implanted ICDs [17].

The subjects enrolled in PANORAMA showed important differences across the regions. Subjects from India and the Middle East were distinct from those in other regional groups in terms of the high prevalence of diabetes and coronary artery disease. This confirms previous publications, and likely reflects genetic and environmental differences and dietary preferences [9,18,19]. Differences across the regions were most pronounced when looking at the indications and type of device, for example in India, Latin America and the Middle East, there was more use of IPG therapy in AV block (a more stark presentation) than sinus node disease and in South Africa very few ICDs were implanted for primary prevention. It is likely that these differences reflect the economic situation and reimbursement and insurance structures within a country,

Table 4
Baseline demographics, device and implant characteristics for CRT cohort by region.

Characteristic	Total n = 1455 n (%)	Eastern Europe n = 400 n (%)	India n = 108 n (%)	Latin America n = 116 n (%)	Middle East n = 276 n (%)	South Africa n = 469 n (%)	Western Europe n = 86 n (%)
Median age, years (IQR)	63 (54,71)	59 (51,67)	58 (50,66)	63 (53,71)	64 (56,72)	64 (56,72)	73 (67,77)
Male	1052 (72)	332 (83)	59 (55)	85 (73)	199 (72)	317 (68)	60 (70)
Body mass index (kg/m ²)							
Mean (SD)	29 (6.0)	29 (5.1)	25 (4.1)	26 (5.0)	30 (6.6)	30 (6.6)	27 (4.7)
Overweight/obese ^a	886 (61%)	260 (65%)	44 (41%)	52 (45%)	206 (75%)	277 (59%)	47 (55%)
Previous or current smoker	568 (39)	206 (52)	17 (16)	38 (33)	131 (47)	141 (30)	35 (41)
Hypertension	785 (54)	232 (58)	26 (24)	59 (51)	183 (66)	241 (51)	44 (51)
Diabetes	433 (30)	70 (18)	43 (40)	24 (21)	172 (62)	97 (21)	27 (31)
Coronary artery disease	616 (42)	199 (50)	46 (43)	33 (28)	139 (50)	143 (31)	56 (65)
Prior myocardial infarction	316 (22)	159 (40)	10 (9)	23 (20)	58 (21)	35 (8)	31 (36)
Coronary artery bypass grafting	245 (17)	74 (19)	17 (16)	8 (7)	47 (17)	71 (15)	28 (33)
Mean ejection fraction, % (SD)	29 (12.2)	28 (7.8)	23 (9.0)	23 (7.8)	25 (9.4)	35 (16.6)	30 (7.2)
NYHA							
I	89 (6)	2 (1)	5 (5)	5 (4)	39 (14)	35 (8)	3 (4)
II	246 (17)	42 (11)	9 (8)	23 (20)	69 (25)	90 (19)	13 (15)
III	689 (47)	273 (68)	71 (66)	55 (47)	141 (51)	107 (23)	42 (49)
IV	318 (22)	82 (21)	23 (21)	25 (22)	22 (8)	163 (35)	3 (4)
No heart failure	93 (6)	1 (<1)	0 (0)	8 (7)	5 (2)	74 (16)	5 (6)
QRS duration, ms							
Not reported	271 (19)	56 (14)	62 (57)	37 (32)	18 (7)	59 (13)	39 (45)
<120	385 (27)	42 (11)	4 (4)	12 (10)	45 (16)	275 (59)	7 (8)
120 to 150	378 (26)	120 (30)	9 (8)	26 (22)	128 (46)	79 (17)	16 (19)
>150	421 (29)	182 (46)	33 (31)	41 (35)	85 (31)	56 (12)	24 (28)
Left bundle branch block	712 (49)	264 (66)	82 (76)	49 (42)	173 (63)	98 (21)	46 (54)
Right bundle branch block	81 (6)	18 (5)	9 (8)	8 (7)	29 (11)	15 (3)	2 (2)
Atrial fibrillation							
Paroxysmal	147 (10)	45 (11)	3 (3)	2 (2)	27 (10)	59 (13)	11 (13)
Persistent/permanent	223 (15)	94 (24)	3 (2)	12 (10)	22 (8)	79 (17)	13 (15)
CHADS2 score 2 or more	931 (64)	265 (66)	53 (49)	65 (56)	211 (76)	285 (61)	52 (61)
CRT defibrillator	682 (50)	212 (53)	31 (29)	87 (75)	234 (85)	58 (12)	60 (70)
Specialization of implanting physician ^b							
Electrophysiologist	775 (53)	175 (44)	108 (100)	74 (64)	273 (99)	116 (25)	29 (34)
Cardiologist	439 (30)	10 (3)	0 (0)	22 (19)	0 (0)	352 (75)	55 (64)
Surgeon	238 (16)	215 (54)	0 (0)	20 (17)	0 (0)	1 (<1)	2 (2)
EP or cardiac catheter lab implant setting	1246 (86)	229 (57)	108 (100)	105 (91)	275 (100)	461 (98)	68 (79)
General anesthesia	154 (11)	15 (4)	0 (0)	45 (39)	5 (2)	78 (17)	11 (13)
LV lead location							
Postero lateral	545 (50)	107 (36)	42 (46)	28 (33)	86 (48)	269 (69)	13 (24)
Middle lateral vein	218 (20)	90 (30)	7 (8)	25 (30)	19 (11)	69 (18)	8 (15)
Basal posterior vein	66 (6)	15 (5)	1 (1)	2 (2)	36 (20)	8 (2)	4 (7)
Middle anterior vein	66 (6)	29 (10)	5 (6)	9 (11)	2 (1)	19 (5)	2 (4)
Middle posterior vein	38 (4)	14 (5)	0 (0)	7 (8)	14 (8)	1 (<1)	2 (4)
Other	113 (11)	34 (11)	30 (33)	8 (10)	21 (12)	20 (6)	0 (0)
Defibrillation testing performed ^c	215 (15)	93 (23)	10 (9)	35 (30)	36 (13)	31 (7)	10 (12)

CRT = cardiac resynchronization therapy; EP = electrophysiology; LV = left ventricular; IQR = interquartile range; SD = standard deviation.

^a Overweight defined as BMI (kg/m²) between 25 and 29 and obese defined as BMI > 30.

^b Specialization of physician was self-reported.

^c Counts and percentages based on CRT-defibrillator devices only. Percentages do not always add to 100, due to missing values.

however, there also seems to be an evolution in pacing indication, from primarily AV block in the early regional pacing era to more sinus node disease when cardiac pacing has become more common [20]. Of the 34 participating countries, 71% are considered to be emerging or developing economies, based on International Monetary Fund (IMF) guidelines [21]. This represents 82% of the study population.

The diagnosis of AF appeared to be comparatively low in Latin America, India and the Middle East. Recent evidence is indicating that even small amounts of AF regardless of symptoms may be correlated with increased stroke risk [22].

Also seen were expected patterns such as the higher use of general anesthesia which reflects local preferences. Other observations were more difficult to explain such as DFT at implants for ICD devices with and without CRT capability. This may reflect changing attitudes about the clinical need for DFT at implant, for which the evidence base is growing [23–25].

In general, the PANORAMA IPG cohort overall was similar to previously reported cohorts. Compared to the DINAMIT and MADIT-II trials,

the PANORAMA ICD cohort had slightly more comorbidities present at implant [26,27] but when compared with previous secondary prevention studies our cohort was similar [28]. We saw a higher prevalence of single chamber ICD use, predominantly in Western Europe, India and South Africa as compared to other regions. This may not only be reflective of economic realities, but may also indicate differing attitudes regarding the level of evidence available for patients without a pacemaker indication [29]. The PANORAMA study included CRT patients with a fairly typical patient profile. When compared to the European CRT survey [16] our cohort was of similar age but had more CRT-P patients and slightly more patients with NYHA II. There were a number of patients receiving CRT therapy despite the lack of documentation of a QRS duration greater than 120 ms. Although it might be possible that the QRS duration has been less documented for those patients with a QRS duration greater than 120 ms, it might also be that the PANORAMA reflects real clinical practice of implanting CRT devices for other (clinical) reasons, irrespective of the QRS duration. There is evidence that CRT devices are electively implanted in patients with a QRS

duration below 150 ms after total AV node ablation for AF [30,31]. However, this cannot be confirmed by the PANORAMA data since prior AV nodal ablation information had not been collected.

Regardless of the reasons for heterogeneity in subjects and therapy practice these differences are likely to impact the outcomes for patients. A smoking history was present in more than 50% of the male ICD and CRT patients, and from the male patients receiving a first ICD up to 24% (Middle East) was smoking at the time of device implant. From the male patients receiving a first CRT the percentage of current smokers was up to 18% (South Africa and Eastern Europe). As failure to stop smoking will likely have a negative impact on survival of these patients, especially those with ischemic heart disease, the PANORAMA data may indicate a need to strongly emphasize smoking cessation possibilities to patients before receiving a medical device.

5. Study limitations

These data need to be interpreted in the context of the limitations of the study. This was a single-manufacturer sponsored study where specific device characteristics might limit applicability across all device manufacturers; however, an attempt was made to compare general therapy parameters that would apply regardless of the manufacturer. In this global analysis, some regions of the world were not represented, but this is the most regionally diverse dataset reported to date. The number of centers and countries represented in the data may not be sufficient to accurately characterize the full regional practice and some of the differences observed could be center specific. Some countries limited the type of device enrolled, so broad conclusions about the proportion of IPG/ICD/CRT use are not possible. To limit overinterpretation, in cases where the number of patients was limited (specific device types), general observations were avoided in this report.

Missing data could have introduced biases and where substantial data was missing it has been reported and interpreted with caution. Some of the measures of patient conditions were collected without specific definition (e.g. hypertension), potentially introducing variability into the response; however, these measures are interpreted in a broad, non-quantitative manner. No adjustments were made for multiple comparisons; however, results are reported with p values so the reader can interpret the clinical and statistical significance of the results.

6. Conclusions

We provide comprehensive descriptive data on patients receiving cardiac rhythm management devices from a range of geographies that is not typically reported in literature; this may aid in the interpretation and application of findings from other studies. We found significant variations in age, cardiovascular diseases, rhythm disturbances, type of device implant, and implant practices across the regions. Some of these may be reflections of larger socioeconomic variations, while others may be due to regional guidelines and practice preferences.

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Conflicts of interest

Fawziah Al Kandari has received consultant honoraries from Medtronic. Juan Bénézet has received consultant honoraries and speaker fees from Medtronic. Ajay Naik has received consultant honoraries from Medtronic, St. Jude Medical, Boston Scientific, Biotronik, Sanofi and Astra Zeneca. Teena West and Reece Holbrook are Medtronic employees.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <http://dx.doi.org/10.1016/j.ijchv.2014.06.008>.

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