Preface

The APHRS was founded in 2008 with the goal to promote the care, education, and research in heart rhythm disorders in Asia-Pacific countries. In pursuit of this goal, the APHRS has developed a White Book in 2010 under the leadership of Prof Shu Zhang, China, to collect basic statistical data and other information on the current status of interventional therapies for cardiac arrhythmia in Asia-Pacific countries. Such data have never been available before.

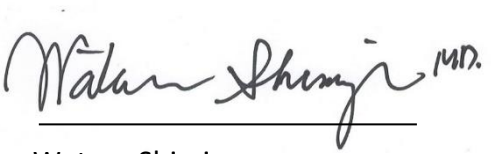
Interventional therapies for cardiac arrhythmias have developed rapidly in the Asia-Pacific region in recent decades, accompanied by the rapid growth of electrophysiological procedures and use of cardiac implantable electronic devices (CIEDs). However, significant inequalities exist in healthcare across Asia-Pacific countries and regions and in treatment of cardiac arrhythmia specifically, which highlight the importance and the necessity for the healthcare community to share, recognize, and communicate within itself the data and information on the current status of cardiac electrophysiology and arrhythmia treatment. My fellow members and I hope that the annually updated White Book will not only promote scientific, technological, and clinical development for better treatment of cardiac arrhythmias, but also improve healthcare and reduce inequalities in care for patients across Asia-Pacific countries and regions.

The APHRS White Book reports the most updated and comprehensive information on the current situation in the field of arrhythmia treatment, encompassing country demographics, epidemiology of cardiac arrhythmia, usage of CIEDs (pacemakers, implantable cardioverter defibrillators, and cardiac resynchronization therapy), and interventional electrophysiology. Prof Zhang first presented such data from 7 countries in the scientific session of APHRS 2012, and the next year the Society published the first edition of the APHRS White Book during the scientific session of APHRS 2013. Since then, the APHRS White Book has been updated each year. With the continuous efforts of the Society in the past 9 years, the APHRS White Book has gained increasing attention from researchers and clinicians across Asia-Pacific countries and regions.

The current Tenth Edition of the APHRS White Book is much extended. This new edition comprises data from 18 countries and regions. As before, data collection is

mostly the result of voluntary participation of each county or region's representative Society of Pacing and Electrophysiology or Heart Rhythm Society. In some other Asia-Pacific countries, there are currently no registries and data are limited. As such, the APHRS White Book marks the beginnings of an international registry compiled by collaborative efforts between countries, which may also encourage the adoption of a systematic approach to data collection on arrhythmia therapies in each country and region.

May I take this opportunity to thank and congratulate Prof. Zhang and his team for putting this excellent job together. I would also like to thank the country representatives and members of individual national HRS working group who have voluntary contributed important data from their countries.



Wataru Shimizu
President of APHRS (2022)

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Shu Zhang, MD, PhD, FHRS, FESC
Chief Editor of the APHRS White Book 2022

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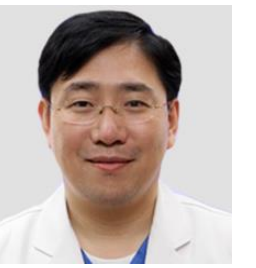

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Country/Region: PR.China

1. Statistics

	2018	2019	2020	2021
Population(thousand)[1]	1395380	1400050	1411780	1411780
Hospitals	33009	34354	35394	37000
Beds(per 100,000 population) [1]	572.20	630	646	646
Physicians(per 1,000 population)[1]	2.4	2.4	2.9	2.9
Nurses(per 1,000 population)[1]	2.7	2.7	3.3	3.3
GDP (US$, billions)[3]	134572.67	143647.03	158800	177300
Total expenditure on health as % GDP[2]	6.2%	6.6%	7.82%	7.81%
Government expenditure on health as %	30.88%	30.88%	30.40%	30.40%
Insured citizens (%)	70%	70%	70%	96%
SCD patients	0.54m	0.54m	0.54m	0.54m
Heart failure patients	4.5m	4.5m	4.5m	13m
AF patients	8m	8m	8m	20m

1, www.stats.gov.cn

2, www.who.int

3, www.imf.org

2. Pacemaker

	2018	2019	2020	2021
Total Pacemakers	82779	90524	86181	111678
New implants	68660	72419		89343
Replacements	14119	18105		22335
Single-chamber	20853	26959	23731	26258
Dual-chamber	61926	63565	62450	85420
Sick sinus syndrome	40008	45388		56162
AV block	34938	39396		48747
Implanting Centers	1066	946		970
Implanting Physicians	3000	3433		3895
National Registry	☑			

3. Cardiac resynchronization therapy

	2018	2019	2020	2021
Total CRTs	4432	4523	3896	5956
CRT-P	1724	1628		1859
CRT-P new implants				
CRT-P replacements/upgrade				
CRT-D	2708	2895	2525	4097
CRT-D new implants				
CRT-D replacements/upgrade				
Ischemic	1460	1492		1948
Non-ischemic	2972	3031		4008
Implanting Centers	410	366		377
Implanting Physicians	3000	3433		1950
National Registry	☑			

4. Implantable cardioverter defibrillator

	2018	2019	2020	2021
Total ICDs	4471	5031	4800	8172
ICD new implants	3897			
ICD replacements	574			
Single-chamber	2739	3119	2392	4950
Dual-chamber	1732	1912	2408	3222
Primary prevention	2129	2264	2540	3188
Secondary prevention	2342	2767	2260	4984
Implanting Centers	459	408		453
Implanting Physicians	3000	3433		1950
National Registry	☑			

5. Interventional electrophysiology

	2018	2019	2020	2021
Ablation procedures	151595	173950	156873	210609
SVT ablation procedures	76971	77557		77996
AVNRT	38754	38975		
AVRT/WPW	26447	30065		
AFL (RA isthmus dependent)	6428	4628		
AT	5342	3889		
VT/VPC				36007
Idiopathic				
Structural				
AF ablation procedures	48317	57275	56012	87994
Ablation centers	886	812		1676
AF ablation centers	429			769
Structural VT ablation centers				432
Ablation physicians	2000	2289		3300
AF ablation physicians				
Structural VT ablation physicians				
National Registry	☑			

6. Management

National certification for physicians	☐PM	☐CRT	☐ICD	☐ Ablation
National accreditation for centers	☐PM	☐CRT	☐ICD	☐ Ablation
Guidelines followed	☐ National	☐U.S.	☐Europe	☐AP

Payment (%)	Pacemaker	ICD	CRT	Ablation
Government	-	-	-	-
Insurance	-	-	-	-
Public insurance	-	-	-	-
Private insurance	-	-	-	-
Individual	-	-	-	-

Obstacles to guideline implementation (1=no obstacle, 5=great obstacle)

	1	2	3	4	5
Lack of centers	☑	☐	☐	☐	☐
Lack of reimbursement, limited financial resources	☐	☐	☐	☑	☐
Lack of referral	☐	☐	☑	☐	☐
Lack of trained personnel	☐	☐	☑	☐	☐
Low awareness of guidelines	☐	☐	☑	☐	☐
Lack of operators	☐	☐	☑	☐	☐

7. Source

Working Group of National Quality Control of Interventional Arrhythmic Therapy and Industrial Company

Country/Region: Brunei Darussalam

1. Statistics

	2018	2019	2020	2021
Population (thousand)	442	459	453	
Hospitals	6	6	6	
Beds				
Physicians				
Nurses				
GDP (US$, billions)	13.5	13.4	12.2	
Total expenditure on health as % GDP	1.9	2.1	2.3	
Government expenditure on health (US$)	255,750,000	286,440,000	277,000,000	
Insured citizens (%)				
SCD patients				
Heart failure patients				
AF patients				

2. Pacemaker

	2018	2019	2020	2021
Total Pacemakers	75	52	81	61
New implants	67	40	63	47
Replacements	8	12	18	14
Single-chamber	27	11	26	19
Dual-chamber	48	41	55	42
Sick sinus syndrome		30	44	41
AV block		18	30	14
Implanting Centers	2	2	2	2
Implanting Physicians	5	6	6	5
National Registry				

	2018	2019	2020	2021
SSS	45	30	44	41

AVN	21	18	30	14
Bi Nodal	7	3	3	5
Others	2	1	4	1

3. Cardiac resynchronization therapy

	2018	2019	2020	2021
Total CRTs	13	19	22	18
CRT-P	4	4	8	2
CRT-P new implants	0	4	3	1
CRT-P replacements/upgrade	4	0	5	1
CRT-D	9	15	14	16
CRT-D new implants	5	13	11	8
CRT-D replacements/upgrade	4	2	3	8
Ischemic	7	10	11	7
Non-ischemic	2	9	11	11
Implanting Centers	2	2	2	2
Implanting Physicians	2	1	1	1
National Registry				

4. Implantable cardioverter defibrillator

	2018	2019	2020	2021
Total ICDs	31	44	30	27
ICD new implants	30	37	27	22
ICD replacements	1	7	3	5
Single-chamber	2	1	3	4
Dual-chamber	29	43	27	23
Primary prevention	23	35	25	17
Secondary prevention	7	9	5	10
Implanting Centers	2	2	2	2
Implanting Physicians	5	6	6	6
National Registry				

5. Lead Extraction

Lead extractions procedures and number of centers that performed lead extraction

	2018	2019	2020	2021
Total lead extraction procedures	6	2	2	3
Hospitals performed lead extraction	1	1	1	1
Cardiologists performing lead extraction	1	1	1	1
Surgeons performing lead extraction	0	0	0	0
National Registry				

6. Interventional electrophysiology

	2018	2019	2020	2021
Ablation procedures	149	103	92	102
SVT ablation procedures	29	41	29	37
AVNRT	21	10	14	17
AVRT/WPW	8	11	4	8
AFL(RA isthmus dependent)	9	11	5	7
AT	3	9	6	5
VT/VPC	7	15	30	22
Idiopathic	3	9	17	19
Structural	4	6	13	3
AF ablation procedures	59	47	33	43
Ablation centers	-			
AF ablation centers	1	1	1	1
Structural VT ablation centers	1	1	1	1
Ablation physicians	-			
AF ablation physicians	2	1	1	1
Structural VT ablation physicians	1	1	1	1
National Registry				

7. Management

National certification for physicians	☐PM	☐CRT	☐ICD	☐Ablation
National accreditation for centers	☐PM	☐CRT	☐ICD	☐Ablation
Guidelines followed	☐National	☑U.S.	☑Europe	☐AP

Payment (%)	Pacemaker	ICD	CRT	Ablation
Government				
Insurance				
Public insurance				
Private insurance				
Individual				

Obstacles to guideline implementation (1=no obstacle, 5=great obstacle)

	1	2	3	4	5
Lack of centers	☐	☑	☐	☐	☐
Lack of reimbursement, limited financial resources	☐	☑	☐	☐	☐
Lack of referral	☐	☑	☐	☐	☐
Lack of trained personnel	☐	☑	☐	☐	☐
Low awareness of guidelines	☐	☑	☐	☐	☐
Lack of operators	☐	☑	☐	☐	☐

8. Source

Cardiac Society, Brunei Darussalam
Ministry of Health, Brunei Darussalam
Department of Economic Planning and Development, Prime Minister's Office, Brunei Darussalam

Country/Region: Cambodia

1. Statistics

	2018	2019	2020	2021
Population (thousand)				
Hospitals				
Beds				
Physicians				
Nurses				
GDP (US$, billions)				
Total expenditure on health as % GDP				
Government expenditure on health (US$)				
Insured citizens (%)				
SCD patients				
Heart failure patients				
AF patients				

2. Pacemaker

	2018	2019	2020	2021
Total Pacemakers	218	261	105	219
New implants	198	210	78	190
Replacements	14	51	17	29
Single-chamber	98	49	38	72
Dual-chamber	106	169	40	118
Sick sinus syndrome	100	110	35	92
AV block	118	100	43	98
Implanting Centers	4	5	5	5
Implanting Physicians	7	7	8	9
National Registry	☐			

3. Cardiac resynchronization therapy

	2018	2019	2020	2021
Total CRTs	4	5	3	2
CRT-P	2	2	2	2
CRT-P new implants	2	2	2	2
CRT-P replacements/upgrade				
CRT-D	2	3	1	0
CRT-D new implants	2	3	1	0
CRT-D replacements/upgrade				
Ischemic				
Non-ischemic				
Implanting Centers				
Implanting Physicians				
National Registry				

4. Implantable cardioverter defibrillator

	2018	2019	2020	2021
Total ICDs	2	4	2	2
ICD new implants	2	4	2	2
ICD replacements				
Single-chamber		1	1	1
Dual-chamber	2	3	1	1
Primary prevention				
Secondary prevention	2	4	2	2
Implanting Centers	1	1	2	2
Implanting Physicians	1	1	1	1
National Registry				

5. Lead Extraction

Lead extractions procedures and number of centers that performed lead extraction

	2018	2019	2020	2021
Total lead extraction procedures	1	2	3	2
Hospitals performed lead extraction	1	2	3	2

Cardiologists performing lead extraction	1	1	1	2
Surgeons performing lead extraction				
National Registry				

6. Interventional electrophysiology

	2018	2019	2020	2021
Ablation procedures	201	102	103	125
SVT ablation procedures				
AVNRT	55	25	25	26
AVRT/WPW	45	26	21	18
AFL (RA isthmus dependent)	42	28	29	43
AT	28	10	6	10
VT/VPC	31	21	22	28
Idiopathic	20	21	22	28
Structural				
AF ablation procedures				
Ablation centers	1			
AF ablation centers				
Structural VT ablation centers				
Ablation physicians	2			
AF ablation physicians				
Structural VT ablation physicians				
National Registry				

7. Management

National certification for physicians	☐PM	☐CRT	☐ICD	☐Ablation
National accreditation for centers	☐PM	☐CRT	☐ICD	☐Ablation
Guidelines followed	☐National	☐U.S.	☐Europe	☐AP

Payment (%)	Pacemaker	ICD	CRT	Ablation
Government	yes			some
Insurance				

Public insurance	some			some
Private insurance	some			some
Individual	yes	yes	yes	some

Obstacles to guideline implementation (1=no obstacle, 5=great obstacle)

	1	2	3	4	5
Lack of centers	☐	☐	☐	☑	☐
Lack of reimbursement, limited financial resources	☐	☐	☐	☑	☐
Lack of referral	☐	☐	☑	☐	☐
Lack of trained personnel	☐	☐	☐	☑	☐
Low awareness of guidelines	☐	☐	☑	☐	☐
Lack of operators	☐	☐	☐	☑	☐

8. Source

Country/Region: Hong Kong SAR

1. Statistics

	2018	2019	2020	2021
Population (thousand)[1]	7,482.5	7,520.80	7,428.30	7,401.50
Hospitals	55	55	56	56
Beds	40,434	41,474	42,180	31,887*
Physicians	14,651	15,004	15,298	15,546
Nurses	42,485	44,601	46,168	48,415
GDP (US$, billions)	364.82	367.71	347.53	367.91
Total expenditure on health as % GDP	2.99%	2.88%	7.00%	3.38%
Government expenditure on health (US$)	10,924mil	10,600mil	24,310mil	12,436mil
Insured citizens (%)				
SCD patients				
Heart failure patients				
AF patients				

*Figures include only hospital beds in Hospital Authority hospitals and private hospitals excluding accident and emergency observation beds, day beds and nursery beds, which follow the definition of the Organisation for Economic Co-operation and Development (OECD). On 1 January 2021, the Hospitals, Nursing Homes and Maternity Homes Registration Ordinance (Cap.165) was repealed when the Private Healthcare Facilities Ordinance (Cap. 633) was commenced. Hence, the number of hospital beds previously compiled under 'Cap. 165 Ordinance definition' is no longer applicable

2. Pacemaker

	2018	2019	2020	2021
Total Pacemakers	1958	1810 (including 302 leadless pacemakers)	1662 (including 414 leadless pacemakers)	2073 (including 527 leadless pacemakers)
New implants				
Replacements				

Single-chamber				
Dual-chamber				
Sick sinus syndrome				
AV block				
Implanting Centers	-			
Implanting Physicians	-			
National Registry	☐			

3. Cardiac resynchronization therapy

	2018	2019	2020	2021
Total CRTs	179	164	183	184
CRT-P	71	27	41	36
CRT-P new implants				
CRT-P replacements/upgrade				
CRT-D	108	137	142	148
CRT-D new implants				
CRT-D replacements/upgrade				
Ischemic				
Non-ischemic				
Implanting Centers				
Implanting Physicians				
National Registry				

4. Implantable cardioverter defibrillator

	2018	2019	2020	2021
Total ICDs	268	274	234	330
ICD new implants				
ICD replacements				
Single-chamber				
Dual-chamber				
Primary prevention				
Secondary prevention				
Implanting Centers				

Implanting Physicians				
National Registry				

5. Lead Extraction

Lead extractions procedures and number of centers that performed lead extraction

	2018	2019	2020	2021
Total lead extraction procedures				
Hospitals performed lead extraction				
Cardiologists performing lead extraction				
Surgeons performing lead extraction				
National Registry				

6. Interventional electrophysiology

	2018	2019	2020	2021
Ablation procedures	-	768	656	907
SVT ablation procedures	-			
AVNRT	-			
AVRT/WPW	-			
AFL (RA isthmus dependent)	-			
AT	-			
VT/VPC	-			
Idiopathic	-			
Structural	-			
AF ablation procedures	-			
Ablation centers	-			
AF ablation centers	-			
Structural VT ablation centers	-			
Ablation physicians	-			
AF ablation physicians	-			
Structural VT ablation physicians	-			
National Registry	☐			

7. Management

National certification for physicians	☐PM	☐CRT	☐ICD	☐Ablation
National accreditation for centers	☐PM	☐CRT	☐ICD	☐Ablation
Guidelines followed	☐National	☐U.S.	☐Europe	☐AP

Payment (%)	Pacemaker	ICD	CRT	Ablation
Government	-	-	-	-
Insurance	-	-	-	-
Public insurance	-	-	-	-
Private insurance	-	-	-	-
Individual	-	-	-	-

Obstacles to guideline implementation (1=no obstacle, 5=great obstacle)

	1	2	3	4	5
Lack of centers	☐	☐	☐	☐	☐
Lack of reimbursement, limited financial resources	☐	☐	☐	☐	☐
Lack of referral	☐	☐	☐	☐	☐
Lack of trained personnel	☐	☐	☐	☐	☐
Low awareness of guidelines	☐	☐	☐	☐	☐
Lack of operators	☐	☐	☐	☐	☐

8. Source

Country/Region: India

1. Statistics

	2018	2019	2020	2021
Population (bn)	1.354	1.38	1.39	1.41
Urban Hospitals (Govt. only)	8812	4375	25778	35,000
Beds (Govt. only)	1013017	713986	739024	10,00,000
Physicians	-	1154686	1.25 million	1.35 million
Nurses	-	ANM =860927; RN &RM = 2048979	ANM =0.90 million; RN &RM = 2151850	ANM = 0.94 million ; RN & RM = 2.3 million
GDP (US$ - billion)	2716	3202	2,708.77	3173.40
Total expenditure on health as % GDP	3.66 as per WHO and World Bank 2016 data; 1.5% as per Indian Health Ministry data	4%	3.6%	2.1%
Government expenditure on health as %	1.02	1.6	1.6	2.8%
Insured citizens (in Millions)	482	472	500	514
SCD patients (in Thousands)	202	204	700	800
Heart failure patients (in Millions)	1.145	1.2	1.3-4.6	5.0
AF patients (million)	4.26	4.5	26.6	33

2. Pacemaker

	2018	2019	2020	2021
Total Pacemakers	44700	48,860	44843	53125
New implants	70%	70%	32035	19022
Replacements	30%	30%	12808	27460
Single-chamber	25100	26,028	18829	21562

Dual-chamber	19600	22,832	23864	31563
Sick sinus syndrome	20%	20%	8968	15%
AV block	80%	80%	35875	85%
Implanting Centers	1120	1500	1120	N/A
Implanting Physicians	1560	2000	1000	N/A
National Registry	☒	☑		☒

3. Cardiac resynchronization therapy

	2018	2019	2020	2021
Total CRTs	3000	3608	2816	4106
CRT-P	1200	1372	1120	1598
CRT-P new implants	88%	90%	1008	1446
CRT-P replacements/upgrade	12%	10%	112	152
CRT-D	1800	2236	1696	2458
CRT-D new implants	82%	85%	1425	2249
CRT-D replacements/upgrade	18%	15%	271	209
Ischemic	40%	40%	50%	70%
Non-ischemic	60%	60%	50%	30%
Implanting Centers	345	350	1120	N/A
Implanting Physicians	395	400	1000	N/A
National Registry	☑	☑		☒

4. Implantable cardioverter defibrillator

	2018	2019	2020	2021
Total ICDs	4100	5021	4210	5639
ICD new implants	85%	88%	3793	5091
ICD replacements	15%	12%	517	548
Single-chamber	2800	3360	2608	3245
Dual-chamber	1300	1661	1702	2394
Primary prevention	20%	22%	30%	25%
Secondary prevention	80%	78%	70%	75%
Implanting Centers	400	400	1120	N/A
Implanting Physicians	515	500	1000	N/A

National Registry	☑	☑		☒

5. Lead Extraction

Lead extractions procedures and number of centers that performed lead extraction

	2018	2019	2020	2021
Total lead extraction procedures	170	84	50	N/A
Hospitals performed lead extraction	26	15	15	N/A
Cardiologists performing lead extraction	84	25	25	N/A
Surgeons performing lead extraction	8	6	8	N/A
National Registry	☒	☒		☒

6. Interventional electrophysiology

	2018 (Incomplete data, obtained only from a few centers)	2019 (Data from limited centers)	2020	2021
Ablation procedures	7910	4659	4800	8386
SVT ablation procedures	6642	3328	4000	7155
AVNRT	4066	2342		4343
AVRT/WPW	2152	1482		2160
AFL (RA isthmus dependent)	424	239		409
AT	456	220		243
VT/VPC	1025	597	800	1055
Idiopathic	618	262		80
Structural	407	168		975
AF ablation procedures	215	146	200	176
Ablation centers		66	150	N/A
AF ablation centers		29	15	N/A
Structural VT ablation centers		21	55	N/A
Ablation physicians		54	200	N/A

AF ablation physicians		31	30	N/A
Structural VT ablation physicians		35	80	N/A
National Registry		0		☒

7. Management

National certification for physicians	☐PM	☐CRT	☐ICD	☐Ablation
National accreditation for centers	☐PM	☐CRT	☐ICD	☐Ablation
Guidelines followed	☑National	☑U.S.	☑Europe	☑AP

Payment (%)	Pacemaker	ICD	CRT	Ablation
Government	N/A	N/A	N/A	N/A
Insurance	N/A	N/A	N/A	N/A
Public insurance	N/A	N/A	N/A	N/A
Private insurance	N/A	N/A	N/A	N/A
Individual	N/A	N/A	N/A	N/A

Insurance data – External consultant data, Media source

Obstacles to guideline implementation (1=no obstacle, 5=great obstacle)

	1	2	3	4	5
Lack of centers	☐	☐	☑	☐	☐
Lack of reimbursement, limited financial resources	☐	☐	☐	☑	☐
Lack of referral	☐	☐	☑	☐	☐
Lack of trained personnel	☐	☐	☐	☑	☐
Low awareness of guidelines	☐	☐	☐	☑	☐
Lack of operators	☐	☐	☑	☐	☐

8. Source

DISCLAIMER: The Statistics provided may not be accurate. The data is sourced from various official sites of Government of India, industry, social media and others.

Country/Region: Indonesia

1. Statistics

	2018	2019	2020	2021
Population (thousand)[1]	265,050	268,074	271,066	273,879
Hospitals[1]	2,813	2,877	2,985	3,042
Beds[1]	310,710	321,544	379,548	371,195
Physicians[1]	205,597	228,180	233,064	223,254
Nurses[2]	354,218	345,508	438,234	511,191
GDP (US$, billions)[2]	1,042.17	1,063.5	1,058.4	1,186
Total expenditure on health as % GDP[1,2]	2.87	3.1	3.1	3.1
Government expenditure on health (US$, billion)[3]	7.53	7.83	14.66	11.38
Insured citizens (%)[1]	78	83.94	82.05	87
SCD patients	-	-	-	-
Heart failure patients	-	-	-	-
AF patients	-	-	-	-

1, Indonesian Health Profile 2020, Ministry of Health

2, World Bank

3, Statista.com

2. Pacemaker

	2018	2019	2020	2021
Total Pacemakers	1609	1637	1840	1342
New implants	1522	1518	1714	1194
Replacements	87	119	126	148
Single-chamber	1109	1075	1268	877
Dual-chamber	500	563	572	465
Sick sinus syndrome	555	673	676	551
AV block	1054	964	1102	791
Implanting Centers	65	65	65	67

Implanting Physicians	111	119	119	119
National Registry	☐	☐	☐	☐

3. Cardiac resynchronization therapy

	2018	2019	2020	2021
Total CRTs	62	63	55	64
CRT-P	31	35	32	36
CRT-P new implants	26	26	26	30
CRT-P replacements/upgrade	5	9	6	6
CRT-D	31	28	23	28
CRT-D new implants	28	22	20	24
CRT-D replacements/upgrade	3	6	3	4
Ischemic	34	32	39	18
Non-ischemic	28	31	16	20
Implanting Centers	12	12	11	17
Implanting Physicians	25	25	24	24
National Registry	☐	☐	☐	☐

4. Implantable cardioverter defibrillator

	2018	2019	2020	2021
Total ICDs	49	56	45	66
ICD new implants	44	49	37	59
ICD replacements	5	7	8	7
Single-chamber	35	37	29	47
Dual-chamber	14	19	16	19
Primary prevention	9	10	20	23
Secondary prevention	40	46	25	40
Implanting Centers	14	14	15	21
Implanting Physicians	25	25	26	29
National Registry	☐	☐	☐	☐

5. Lead Extraction

Lead extractions procedures and number of centers that performed lead extraction

	2018	2019	2020	2021
Total lead extraction procedures	6	12	13	36
Hospitals performed lead extraction	8	9	8	12
Cardiologists performing lead extraction	17	17	21	19
Surgeons performing lead extraction	2	7	12	10
National Registry	☐	☐	☐	☐

6. Interventional electrophysiology

	2018	2019	2020	2021
Ablation procedures	880	1193	885	1178
SVT ablation procedures	404	680	283	612
AVNRT	239	377	165	330
AVRT/WPW	165	228	34	213
AFL (RA isthmus dependent)	32	31	34	34
AT	32	44	17	35
VT/VPC	346	433	252	472
Idiopathic	312	386	30	418
Structural	34	47	30	54
AF ablation procedures	67	68	49	84
Ablation centers	16	17	21	23
AF ablation centers	9	11	11	14
Structural VT ablation centers	10	12	13	17
Ablation physicians	24	26	33	29
AF ablation physicians	17	17	22	38
Structural VT ablation physicians	18	20	23	27
National Registry	☐	☐	☐	☐

7. Management

National certification for physicians	☑PM	☑CRT	☑ICD	☑Ablation
National accreditation for centers	☐PM	☐CRT	☐ICD	☑Ablation
Guidelines followed	☑National	☐U.S.	☐Europe	☐AP

Payment (%)	Pacemaker	ICD	CRT	Ablation
Government				
Insurance				
Public insurance				
Private insurance				
Individual				

Obstacles to guideline implémentation (1=no obstacle, 5= great obstacle)

	1	2	3	4	5
Lack of centers	☐	☐	☑	☐	☐
Lack of reimbursement, limited financial resources	☐	☐	☐	☑	☐
Lack of referral	☐	☑	☐	☐	☐
Lack of trained personnel	☐	☐	☑	☐	☐
Low awareness of guidelines	☐	☐	☑	☐	☐
Lack of operators	☐	☑	☐	☐	☐

8. Source

Indonesian Heart Rhythm Society (InaHRS)

Country/Region: Japan

1. Statistics

	2018	2019	2020	2021
Population (thousand)[1]	126,496	126,167	126,226	125,502
Hospitals (per 100,000 population)				
Beds	1,662,567	1,627,288	1,596,328	1,580,892
Physicians (per 1,000 population) [2]				
Nurses (per 1,000 population) [2]				
GDP (US$, billions) [3]	5,036.89	5,148.78	5,048.69	4,937,42
Total expenditure on health as % GDP [2]				
Government expenditure on health as % [2]				
Insured citizens (%)				
SCD patients				
Heart failure patients				
AF patients				

2. Pacemaker

	2018	2019	2020	2021
Total Pacemakers	61238	63411	64277	68337
New implants	43495	44359	43862	45634
Replacements	17743	19052	20415	22703
Single-chamber	13209	12575	12156	12276
Dual-chamber	48029	50836	52121	56061
Sick sinus syndrome				
AV block				
Implanting Centers				
Implanting Physicians				
National Registry				

3. Cardiac resynchronization therapy

	2018	2019	2020	2021

Total CRTs	4778	5149	5475	5543
CRT-P	1330	1503	1620	1645
CRT-P new implants	1041	1201	1279	1244
CRT-P replacements/upgrade	289	302	341	401
CRT-D	3448	3646	3855	3898
CRT-D new implants	2367	2406	2334	2329
CRT-D replacements/upgrade	1081	1240	1521	1569
Ischemic				
Non-ischemic				
Implanting Centers				
Implanting Physicians				
National Registry				

4. Implantable cardioverter defibrillator

	2018	2019	2020	2021
Total ICDs	6772	6552	5779	6092
ICD new implants	4405	4341	3902	3911
ICD replacements	2367	2211	1877	2181
Single-chamber	2039	2096	1802	1847
Dual-chamber	4733	4456	3977	4245
Primary prevention				
Secondary prevention				
Implanting Centers				
Implanting Physicians				
National Registry				

5. Lead Extraction

Lead extractions procedures and number of centers that performed lead extraction

	2018	2019	2020	2021
Total lead extraction procedures	81	580	785	984
Hospitals performed lead extraction	15	41	72	98
Cardiologists performing lead extraction	100	103	138	

Surgeons performing lead extraction	6	6	6	
National Registry	+(J-LEX)	+(J-LEX)	+(J-LEX)	

6. Interventional electrophysiology

	2018	2019	2020	2021
Ablation procedures	80000	96000	100000	102781
SVT ablation procedures	15000	11000	11000	11000
AVNRT		7500	7500	7400
AVRT/WPW		3500	3500	3300
AFL (RA isthmus dependent)		10000	12000	12000
AT		3000	5000	4800
VT/VPC	6000	6000	7000	7200
Idiopathic				
Structural				
AF ablation procedures	59000	62000	74000	76674
Ablation centers	700	700	750	750
AF ablation centers	500	500	550	550
Structural VT ablation centers				
Ablation physicians	2200	2500	2500	2500
AF ablation physicians	1700	2000	2000	2000
Structural VT ablation physicians				
National Registry	☑	☑	☑	☑

7. Management

National certification for physicians	☐PM	☑CRT	☑ICD	☐Ablation
National accreditation for centers	☐PM	☑CRT	☑ICD	☐Ablation
Guidelines followed	☑National	☐U.S.	☐Europe	☐AP

Payment (%)	Pacemaker	ICD	CRT	Ablation
Government	-	-	-	-
Insurance	-	-	-	-

Public insurance	-	-	-	-
Private insurance	-	-	-	-
Individual	-	-	-	-

Obstacles to guideline implementation (1=no obstacle, 5=great obstacle)

	1	2	3	4	5
Lack of centers	☑	☐	☐	☐	☐
Lack of reimbursement, limited financial resources	☑	☐	☐	☐	☐
Lack of referral	☑	☐	☐	☐	☐
Lack of trained personnel	☑	☐	☐	☐	☐
Low awareness of guidelines	☐	☑	☐	☐	☐
Lack of operators	☑	☐	☐	☐	☐

8. Source

Japanese Heart Rhythm Society

Country/Region: Malaysia

1. Statistics

	2018	2019	2020	2021
Population (Thousand)	32,400	32,733	45,010	33,290
Hospitals	148	7	7	7
Beds	42400	1768	1,822	1786
Physicians	53450	715	639	650
Nurses	105,000	3174	2,643	2693
GDP (RM)	49, 999	1，353，380	1,343,353,380	1,353,380
Total expenditure on health as % GDP	4.5	4	4	4.5
Government expenditure on health as %	50.2	7	10	7
Insured citizens (%)	-	32	22	17
SCD patients	-	12%	12%	10%
Heart failure patients	-	1780	1,638	821
AF patients	-	492	927	716

***Data source: Portal Rasmi, Kementerian Kesihatan Malaysia (www.moh.gov.my)**

2. Pacemaker

	2018	2019	2020	2021
Total Pacemakers	755 (PPM), 87 (leadless)	798	883	534
New implants	597	626	668	401

Replacements	166	172	215	128
Single-chamber	252	233	246	185
Dual-chamber	503	560	569	284
Sick sinus syndrome	296	382	439	165
AV block	370	428	431	284
Implanting Centers	38	7	6	51
Implanting Physicians	127	28	26	24
National Registry	☑	☑	-	0

3. Cardiac resynchronization therapy

	2018	2019	2020	2021
Total CRTs	177	160	175	63
CRT-P	55	60	56	16
CRT-P new implants	33	38	34	12
CRT-P replacements/upgrade	22	26	25	4
CRT-D	122	84	110	47
CRT-D new implants	92	73	74	32
CRT-D replacements/upgrade	30	19	42	15
Ischemic	65	51	53	23
Non-ischemic	106	55	76	33
Implanting Centers	16	5	6	5
Implanting Physicians	31	15	15	12
National Registry	☑	☑	–	0

4. Implantable cardioverter defibrillator

	2018	2019	2020	2021
Total ICDs	256	223	207	103
ICD new implants	216	203	204	78
ICD replacements	40	29	46	25
Single-chamber	179	168	184	68
Dual-chamber	76	64	63	22
Primary prevention	91	78	90	4
Secondary prevention	140	154	157	87
Implanting Centers	21	7	6	5
Implanting Physicians	28	23	19	14
National Registry	☑	☑		0

5. Lead Extraction

Lead extractions procedures and number of centers that performed lead extraction

	2018	2019	2020	2021
Total lead extraction procedures	12	19	22	9
Hospitals performed lead extraction	7	4	3	3
Cardiologists performing lead extraction	4	9	8	5
Surgeons performing lead extraction	1	3	3	3
National Registry	☑			0

6. Interventional electrophysiology

	2018	2019	2020	2021
Ablation procedures	822	891	1,038	579
SVT ablation procedures	611	576	524	311
AVNRT	233	251	253	169

AVRT/WPW	96	156	137	89
AFL (RA isthmus dependent)	90	101	129	37
AT	40	70	51	37
VT/VPC	164	238	268	94
Idiopathic	45	100	226	103
Structural	39	59	42	17
AF ablation procedures	101	122	191	85
Ablation centers	5	5	5	47
AF ablation centers	5	4	4	3
Structural VT ablation centers	2	3	5	3
Ablation physicians	13	8	10	9
AF ablation physicians	13	8	9	6
Structural VT ablation physicians	13	7	10	6
National Registry	☑			0

7. Management

National certification for physicians	☑PM	☑CRT	☑ICD	☑Ablation
National accreditation for centers	☑PM	☑CRT	☑ICD	☑Ablation
Guidelines followed	☑National	☑U.S.	☑Europe	☑AP

Payment (%)	Pacemaker	ICD	CRT	Ablation
Government	69.5	80.6	69.0	46.7
Insurance	3.1	1.4	14.3	34.7

Public insurance	0.7			0.8
Private insurance	2.7	1.4	14.3	34.9
Individual	27.7	18.1	16.7	18.6

Obstacles to guideline implementation (1=no obstacle, 5=great obstacle)

	1	2	3	4	5
Lack of centers	☐	☐	☑	☐	☐
Lack of reimbursement, limited financial resources	☐	☐	☐	☑	☐
Lack of referral	☐	☑	☐	☑	☐
Lack of trained personnel	☐	☑	☐	☑	☐
Low awareness of guidelines	☐	☑	☐	☑	☐
Lack of operators	☐	☑	☐	☐	☑

8. Source

QEH2, HRPZII, HPP, UMMC, PJHUS, Hospital Serdang, CVSKL

Country/Region: Mongolia

1. Statistics

	2018	2019	2020	2021
Population (thousand)[1]	3,238.5	3,296,9	3,402,7	3.409.9
Hospitals	13	58	60	57
Beds	24884	25661	27083	35310
Physicians	11169	11788	12431	12970
Nurses	12267	12773	13112	13473
GDP (US$, billions)	1.301	13.85	-	15.10
Total expenditure on health as % GDP	-	4%	5,6%	3,6%
Government expenditure on health (US$)	-	458000.0	-	543600.0
Insured citizens (%)	-	-	-	-
SCD patients	-	-	-	-
Heart failure patients	-	-	-	-
AF patients	-	-	-	-

4, www.census.gov

2. Pacemaker

	2018	2019	2020	2021
Total Pacemakers	166	180	237	276
New implants	153	-	225	258
Replacements	13	-	5	18
Single-chamber	-	-	-	-
Dual-chamber	-	180	237	
Sick sinus syndrome	-	-	60%	-
AV block	-	-	40%	-
Implanting Centers	2	3	3	3
Implanting Physicians	5	6	6	7
National Registry	☒	☒	☒	–

3. Cardiac resynchronization therapy

	2018	2019	2020	2021
Total CRTs	3	3	7	6
CRT-P	3	3	7	6
CRT-P new implants	3	3	5	6
CRT-P replacements/upgrade	-	-	-	-
CRT-D	-	-	2	-
CRT-D new implants	-	-	2	-
CRT-D replacements/upgrade	-	-	2	-
Ischemic	-	-	2	-
Non-ischemic	3	3	1	6
Implanting Centers	1	1	1	1
Implanting Physicians	1	1	1	3
National Registry		☒	☒	–

4. Implantable cardioverter defibrillator

	2018	2019	2020	2021
Total ICDs	5	1	4	4
ICD new implants	5	1	4	4
ICD replacements	-	-		-
Single-chamber	-	-	1	-
Dual-chamber	5	1	3	4
Primary prevention	-	-	-	-
Secondary prevention	5	-	4	4
Implanting Centers	1	1	1	1
Implanting Physicians	2	2	2	3
National Registry			☒	–

5. Lead Extraction

Lead extractions procedures and number of centers that performed lead extraction

	2018	2019	2020	2021
Total lead extraction procedures	-	1	1	1

Hospitals performed lead extraction	-	1	1	1
Cardiologists performing lead extraction	-	2	2	3
Surgeons performing lead extraction	-	-	-	-
National Registry		☒	☒	–

6. Interventional electrophysiology

	2018	2019	2020	2021
Ablation procedures	74	156	90	113
SVT ablation procedures	70	140	86	111
AVNRT	32	98	46	75
AVRT/WPW	26	32	40	33
AFL(RA isthmus dependent)	5	6	1	4
AT	4	4	-	-
VT/VPC	2	10	3	2
Idiopathic	2	10	3	2
Structural		-	-	-
AF ablation procedures	4	6	-	-
Ablation centers	1	1	1	1
AF ablation centers	1	1	1	1
Structural VT ablation centers	1	1	1	1
Ablation physicians	2	2	3	3
AF ablation physicians	1	1	1	1
Structural VT ablation physicians	1	1	1	1
National Registry		☒	☒	–

7. Management

National certification for physicians	☐PM	☐CRT	☐ICD	☐Ablation
National accreditation for centers	☐PM	☐CRT	☐ICD	☐Ablation
Guidelines followed	☐National	☐U.S.	☑Europe	☐AP

Payment (%)	Pacemaker	ICD	CRT	Ablation
Government	90%-100%	90%-100%	90%-100%	90%-100%
Insurance				

Public insurance	90%-100%	90%-100%	90%-100%	90%-100%
Private insurance				
Individual	Up to 10%	Up to 10%	Up to 10%	Up to 10%

Obstacles to guideline implementation (1=no obstacle, 5=great obstacle)

	1	2	3	4	5
Lack of centers	☐	☐	☐	☐	☑
Lack of reimbursement, limited financial resources	☐	☐	☑	☐	☐
Lack of referral	☐	☐	☑	☐	☐
Lack of trained personnel	☐	☐	☐	☐	☑
Low awareness of guidelines	☐	☐	☐	☑	☐
Lack of operators	☐	☐	☐	☐	☑

8. Source

State Third Central Hospital, National Cardiac Center
Mongolian Heart Rhythm Society

Country/Region: Myanmar

1. Statistics

	2018	2019	2020	2021
Population (thousand)	53850	54425	54000	54000
Hospitals (implanting)	10	11	12	12
Beds				
Physicians				
Nurses				
GDP (US$, billions)	74			
Total expenditure on health as % GDP				
Government expenditure on health as %				
Insured citizens (%)				
SCD patients				
Heart failure patients				
AF patients				

2. Pacemaker

	2018	2019	2020	2021
Total pacemakers	648	641	509	483
New implants	624	610	479	431
Replacements	24	31	30	52
Single-chamber	589	572	475	422
Dual-chamber	59	69	34	61
Sick sinus syndrome	317	296	259	264
AV block	331	345	250	219
Implanting Centers	10	11	12	12
Implanting Physicians	21	21	21	21
National Registry		–	–	

3. Cardiac resynchronization therapy

	2018	2019	2020	2021
Total CRTs	13	11	1	1
CRT-P	2	1		
CRT-P new implants	2	1		
CRT-P replacements/ upgrade	-			
CRT-D	11	10	1	1
CRT-D new implants	11	10		
CRT-D replacements/upgrade			1	1
Ischaemic	5	6	1	
Non-ischaemic	8	5		1
Implanting Centers	4	4	4	4
Implanting physicians	15	15	15	15
National Registry		–	–	–

4. Implantable cardioverter defibrillator

	2018	2019	2020	2021
Total ICDs	24	37	22	15
ICD new implants	20	37	21	12
ICD replacements	4	-	1	3
Single-chamber	21	32	19	15
Dual-chamber	3	5	3	-
Primary prevention	9	21	12	9
Secondary prevention	15	16	10	6
Implanting Centers	4	5	6	6
Implanting physicians	15	15	15	15
National Registry		–	–	–

5. Lead extraction

	2018	2019	2020	2021
Total lead extraction procedure	-	-	1	–
Hospitals performed lead extraction	-	-	1	
Cardiologists performing lead extraction	-	-	2	
Surgeons performing lead extraction	-	-	-	

National Registry	-	-	-	

6. Interventional Electrophysiology

	2018	2019	2020	2021
Ablation procedures	960	1034	601	296
SVT ablation procedures	891	945	555	257
AVNRT	461	519	303	149
AVRT/WPW	398	408	237	100
AFL (RA isthmus dependent)	17	10	5	-
AT	13	15	8	8
VT/PVC	66	58	76	39
Idiopathic	62	56	69	37
Structural	4	2	7	2
AF ablation procedures	13	11	13	-
Ablation centers	4	5	6	6
AF ablation centers	1	1	1	1
Structural VT ablation centers	1	1	1	1
Ablation physicians	10	13	13	13
AF ablation physicians	1	1	1	1
Structural VT ablation physicians	1	1	1	1
National Registry	☐	☐		–

7. Management

National certification for physicians	☐PM	☐CRT	☐ICD	☐Ablation
National accreditation for centers	☐PM	☐CRT	☐ICD	☐Ablation
Guidelines followed	☐National	☑U.S.	☑Europe	☑AP

Payment (%)	Pacemaker	ICD	CRT	Ablation
Government	80 %	-	-	100 %
Insurance	-	-	-	-
Public insurance	-	-	-	-
Private insurance	-	-	-	-
Individual	20 %	100 %	100 %	-

Obstacles to guideline implementation (1=no obstacle, 5=great obstacle)

	1	2	3	4	5
Lack of centers	☑	☐	☐	☐	☐
Lack of reimbursement, limited financial resources	☐	☐	☐	☑	☐
Lack of referral	☐	☑	☐	☐	☐
Lack of trained personnel	☐	☑	☐	☐	☐
Low awareness of guidelines	☐	☑	☐	☐	☐
Lack of operators	☐	☑	☐	☐	☐

8. Source

Yangon General Hospital, North Okkalapa General Hospital, Mandalay General Hospital, No (1) Defense Services General Hospital, No (2) Defense Services General Hospital, Naypyitaw 1000 bedded Hospital, Private Hospitals in Yangon

Country/Region: New Zealand

1. Statistics

	2018	2019	2020	2021
Population (thousand)[1]	4929	5000	4822	5000
Hospitals *(includes every small hosp.)*	220			
Beds *(includes every small hosp.)*	13010			
Physicians	15819			
Nurses	58206			
GDP(US$, billions)[2]	206			
Total expenditure on health as % GDP[2]	9%			
Government expenditure on health as %[2]	80%			
Insured citizens (%)				
SCD patients				
Heart failure patients				
AF patients				

5, www.census.gov

6, www.imf.org

2. Pacemaker

	2018	2019	2020	2021
Total Pacemakers	2635	2644	2670	2505
New implants	2133	2142	2062	1710
Replacements	502	502	603	423
Single-chamber	829	773	647	495
Dual-chamber	1806	1763	1848	1471
Sick sinus syndrome				83
AV block				84
Implanting Centers	14	14	14	14
Implanting Physicians	38	39	39	48
National Registry		☑	☑	

3. Cardiac resynchronization therapy

	2018	2019	2020	2021
Total CRTs	329	318	347	339
CRT-P	168	168	210	171
CRT-P new implants	107	106	121	81
CRT-P replacements/upgrade	61	62	37	52
CRT-D	161	150	137	139
CRT-D new implants	121	108	74	48
CRT-D replacements/upgrade	40	42	23	47
Ischemic			6	31
Non-ischemic			45	33
Implanting Centers	8	9	9	9
Implanting Physicians	22	23	35	27
National Registry				

4. Implantable cardioverter defibrillator

	2018	2019	2020	2021
Total ICDs	649	602	457	585
ICD new implants	479	416	319	421
ICD replacements	170	186	138	164
Single-chamber			120	
Dual-chamber			70	
Primary prevention			5	
Secondary prevention			18	
Implanting Centers		9	9	9
Implanting Physicians		23	24	27
National Registry		☑	☑	

5. Lead Extraction

Lead extractions procedures and number of centers that performed lead extraction

	2018	2019	2020	2021
Total lead extraction procedures	40	42	52	40
Hospitals performed lead extraction	1	1	1	1

Cardiologists performing lead extraction	2	2	2	2
Surgeons performing lead extraction		Support		
National Registry				

6. Interventional electrophysiology

	2018	2019	2020	2021
Ablation procedures	1725	1788	2056	1383
SVT ablation procedures	882	1029	921	722
AVNRT	274	300	252	208
AVRT/WPW	178	146	125	117
AFL (RA isthmus dependent)	335	391	420	318
AT	80	80	111	44
VT/VPC	152	153	120	64
Idiopathic			36	22
Structural			22	44
AF ablation procedures	563	644	730	429
Ablation centers				
AF ablation centers	8	8	8	8
Structural VT ablation centers	4	7	7	7
Ablation physicians				
AF ablation physicians	15	16	21	21
Structural VT ablation physicians	15	16	21	21
National Registry		☒	☒	x

7. Management

National certification for physicians	☐PM	☐CRT	☐ICD	☐Ablation
National accreditation for centers	☐PM	☐CRT	☐ICD	☐Ablation
Guidelines followed	☑National	☐U.S.	☐Europe	☐AP

[7]

Payment (%)	Pacemaker	ICD	CRT	Ablation

Government				
Insurance				
Public insurance				
Private insurance				
Individual				

Obstacles to guideline implementation (1=no obstacle, 5=great obstacle)

	1	2	3	4	5
Lack of centers	☐	☐	☑	☐	☐
Lack of reimbursement, limited financial resources	☐	☑	☐	☐	☐
Lack of referral	☐	☐	☑	☐	☐
Lack of trained personnel	☐	☑	☐	☐	☐
Low awareness of guidelines	☐	☐	☑	☐	☐
Lack of operators	☐	☑	☐	☐	☐

8. Source

"Heart Rhythm New Zealand" ---- a branch of the Cardiac Society of Australia and New Zealand

Asia Pacific Heart Rhythm Society APHRS

Country/Region: Philippines

1. Statistics

	2018	2019	2020	2021
Population (thousand) *	106,512	109,938,244	110,818	112321
Hospitals	1800	1800	1800	1800
Beds (per 100,000 population)**	100	135	150	150
Physicians (per 1,000 population) ***	1.16	1.16	1.16	1.16
Nurses (per 1,000 population) ****	24	24	24	24
GDP (US$, billions) *****	354.31	376.79	377.205	394.09
Total expenditure on health as % GDP	4.5%	7.1%	4.4%	4.60%
Government expenditure on health as %	33%	33%	33%	33%
Insured citizens (%)	93%	93%	93%	93%
SCD patients	–	–	–	–
Heart failure patients	-	-	-	-
AF patients	0.2%	0.2%	0.40%	0.40%

*http://www.worldometers.info/world-population/philippines-population/

** http://statista.com

*** http://data.worldbank.org/indicator/SH.MED.BEDS.ZS

**** http://www.who.int/whosis/whostat/EN_WHS2011_Full.pdf

***** http://www.tradingeconomics.com/philippines/gdp-growth-annual

2. Pacemaker

	2018	2019	2020	2021
Total Pacemakers	1037	1335	898	520

New implants	974	1168	768	410
Replacements	63	167	130	119
Single-chamber	414	526	352	120
Dual-chamber	617	778	546	281
Sick sinus syndrome	346	197	211	212
AV block	691	84	140	189
Implanting Centers	72	42	45	69
Implanting Physicians	76	55	58	65
National Registry	☐	☐		N/A

3. Cardiac resynchronization therapy

	2018	2019	2020	2021
Total CRTs	15	27	26	14
CRT-P	1	3	4	2
CRT-P new implants	0	1	3	1
CRT-P replacements/upgrade	1	2	1	1
CRT-D	14	24	22	12
CRT-D new implants	13	18	20	6
CRT-D replacements/upgrade	1	6	2	6
Ischemic	4	5	5	8

Non-ischemic	11	2	3	4
Implanting Centers	6	4	11	11
Implanting Physicians	6	6	20	20
National Registry	☐	☐	N/A	N/A

4. Implantable cardioverter defibrillator

	2018	2019	2020	2021
Total ICDs	72	109	85	42
ICD new implants	70	98	73	36
ICD replacements	2	11	12	6
Single-chamber	53	61	45	26
Dual-chamber	19	48	40	16
Primary prevention	45	26	25	24
Secondary prevention	27	11	17	18
Implanting Centers	12	10	11	15
Implanting Physicians	11	9	20	23
National Registry	☐	☐	N/A	N/A

5. Lead Extraction

Lead extractions procedures and number of centers that performed lead extraction

	2018	2019	2020	2021
Total lead extraction procedures	-	-	-	–
Hospitals performed lead extraction	-	-	-	–

Cardiologists performing lead extraction	-	-	-	–
Surgeons performing lead extraction	-	-	-	–
National Registry	☐	☐	☐	N/A

6. Interventional electrophysiology

	2018	2019	2020	2021
Ablation procedures	137	153	69	114
SVT ablation procedures	-		60	93
AVNRT	46	60	26	36
AVRT/WPW	47	55	30	45
AFL (RA isthmus dependent)	6	1	2	2
AT	4	1	2	10
VT/VPC	16	19	5	11
Idiopathic	-	-	5	11
Structural	-	-	0	0
AF ablation procedures	18	17	4	10
Ablation centers	4	4	4	4
AF ablation centers	4	4	3	4
Structural VT ablation centers	4	4	3	4
Ablation physicians	-	-	20	6
AF ablation physicians	-	-	-	6

Structural VT ablation physicians	-	-	-	6
National Registry	☐	☐	N/A	N/A

7. Management

National certification for physicians	☐PM	☐CRT	☐ICD	☐Ablation
National accreditation for centers	☐PM	☐CRT	☐ICD	☐Ablation
Guidelines followed	☐Nationa	☑U.S.	☐Europe	☐AP

Payment (%)	Pacemaker	ICD	CRT	Ablation
Government	5%	5%	5%	5%
Insurance				
Public insurance	5%	5%	5%	5%
Private insurance	0	0	0	0
Individual	90%	90%	90%	90%

Obstacles to guideline implementation (1=no obstacle, 5=great obstacle)

	1	2	3	4	5
Lack of centers	☐	☐	☑	☐	☐
Lack of reimbursement, limited financial resources	☐	☐	☐	☐	☑
Lack of referral	☐	☐	☑	☐	☐
Lack of trained personnel	☐	☐	☐	☑	☐
Low awareness of guidelines	☐	☐	☐	☑	☐
Lack of operators	☐	☐	☐	☑	☐

8. Source

a. Philippine Heart Rhythm Society, Inc.

b. Different ablation centers

c. Other Sources:

Medtronic Phils.

Abbott Phils.

Boston Phils.

Transmedic Phils.

Country/Region: Singapore

1. Statistics

	2018	2019	2020	2021
Population ('000)[1]	**5,638.7**	**5,703.6**	**5,685.8**	**5,453.6**
Hospitals [2]	**28**	**29**	**28**	**29**
a. Public Sector	*15*	*16*	*16*	*16*
- Acute Hospitals	*10*	*10*	*10*	*10*
- Psychiatric Hospitals	*1*	*1*	*1*	*1*
- Community Hospitals	*4*	*5*	*5*	*5*
b. Not-for-Profit	*5*	*5*	*5*	*5*
- Acute Hospitals	*1*	*1*	*1*	*1*
- Psychiatric Hospitals	*-*	*-*	*-*	*-*
- Community Hospitals	*4*	*4*	*4*	*4*
c. Private Sector	*8*	*8*	*7*	*8*
- Acute Hospitals	*8*	*8*	*7*	*8*
- Psychiatric Hospitals	*-*	*-*	*-*	*-*
- Community Hospitals	*-*	*-*	*-*	*-*
Beds[3]	**29,938**	**31,495**	**32,038**	**32,928**
a. Public Sector	*17,425*	*18,590*	*19,081*	*19,927*
- Acute Hospitals	*9,071*	*9,404*	*9,610*	*9,762*
- Psychiatric Hospitals	*1,950*	*1,950*	*1,950*	*1,950*
- Community Hospitals	*799*	*974*	*1,130*	*1,180*
- Nursing Homes	*5,581*	*6,238*	*6,391*	*6,971*
- Inpatient Hospices	*24*	*24*	*-*	*-*
*- IHPCS**	*-*	*-*	*60*	*64*
b. Not-for-Profit	*7,360*	*7,418*	*7,380*	*7,424*
- Acute Hospitals	*273*	*288*	*285*	*270*
- Psychiatric Hospitals	*-*	*-*	*-*	*-*
- Community Hospitals	*979*	*1,012*	*939*	*899*
- Nursing Homes	*5,953*	*5,963*	*5,963*	*6,060*

- Inpatient Hospices	*155*	*155*	*-*	*-*
*- IHPCS**	*-*	*-*	*193*	*195*
b. Private Sector	*5,153*	*5,487*	*5,517*	*5,577*
- Acute Hospitals	*1,482*	*1,629*	*1,650*	*1,672*
- Psychiatric Hospitals	*-*	*-*	*-*	*-*
- Community Hospitals	*-*	*-*	*-*	*-*
- Nursing Homes	*3,671*	*3,858*	*3,867*	*3,905*
- Inpatient Hospices	*-*	*-*	*-*	*-*
*- IHPCS**	*-*	*-*	*-*	*-*
Physicians[4]	**13,766**	**14,279**	**14,823**	**15,423**
a. Public Sector	*8,819*	*9,030*	*9,532*	*9,844*
b. Private Sector	*4,225*	*4,439*	*4,489*	*4,601*
c. *Not in active Practice*	*722*	*810*	*802*	*978*
Nurses/Midwives[4]	**42,125**	**42,777**	**42,173**	**43,005**
- Registered Nurses	*33,614*	*34,609*	*34,654*	*35,948*
- Enrolled Nurses	*8,394*	*8,059*	*7,442*	*6,989*
- Registered Midwives	*117*	*109*	*77*	*68*
Advanced Practice Nurses[4]	**238**	**267**	**264**	**330**
GDP (US$, billions)				
Government Health Expenditure (as % of GDP)[5]	**2.1**	**2.2**	**3.6**	**3.7#**
Government Health Expenditure (as % of Total Government Expenditure)[5]	**13.4**	**15.0**	**17.7**	**18.4#**
Insured citizens (%)	-	-	-	-
SCD patients	-	-	-	-
Heart failure patients	-	-	-	-
AF patients	-	-	-	-

Source: Singapore Health Facts, Singapore Department of Statistics, Ministry of Health, Singapore and data.gov.sg retrieved as of 28 September 2022[1,2,3,4,5] (www.moh.gov.sg).

* The new Inpatient Palliative Care Services (IHPCS) started on Apr 2020, replacing Inpatient Hospice and Community Hospital Palliative Care Services, and are tracked separately from 2020 onwards.

Estimated figures

2. Pacemaker

	2018	2019	2020	2021
Total Pacemakers[4]	**875**	**928**	**910**	**957**
- New implants	589	620	613	616
Replacements/Upgrades	139	135	143	169
Others	147	173	154	172
- Single-chamber	143	131	97	147
Dual-chamber	591	621	673	641
Not applicable	141	176	140	169
- Sick sinus syndrome	377	338	360	361
AV block*	230	259	282	287
Implanting Centers[4]	6	6	6	6
Implanting Physicians[4]	~25	~27	~22	~25
National Registry[4]	☑	☑	☑	☑

Source: CGH, KTPH, NHCS, NTFGH, NUHCS, TTSH, SCDB as of 28 September 2022[4]

** refer to Complete AV Block only.*

CGH: Changi General Hospital, KTPH: Khoo Teck Puat Hospital, NHCS: National Heart Centre Singapore, NTFGH: Ng Teng Fong General Hospital, NUHCS: National University Heart Centre Singapore, TTSH: Tan Tock Seng Hospital, SCDB: Singapore Cardiac Data Bank

3. Cardiac resynchronization therapy

	2018	2019	2020	2021
Total CRTs[4]	**184**	**205**	**177**	**172**
- CRT-P	38	52	48	39
CRT-P new implants	16	30	31	9
CRT-P replacements/upgrade	22	20	15	28
Others	-	2	2	2
- CRT-D	146	153	129	133
CRT-D new implants	100	101	76	65

CRT-D replacements/upgrade	42	41	48	59
Others	4	11	5	9
- Ischemic	92	94	79	63
Non-ischemic	26	49	51	70
Implanting Centers[4]	6	6	6	6
Implanting Physicians[4]	~22	~25	~21	~22
National Registry[4]	☑	☑	☑	☑

Source: CGH, KTPH, NHCS, NTFGH, NUHCS, TTSH, SCDB as of 28 September 2022[4]

4. Implantable cardioverter defibrillator

	2018	***2019***	***2020***	***2021***
Total ICDs[4]	**394**	**345**	**410**	**363**
- ICD new implants	288	222	238	225
ICD replacements/upgrade	64	77	130	*100*
Others	42	46	42	38
- Single-chamber	311	246	296	276
Dual-chamber	54	70	78	63
Others	29	29	36	24
- Primary prevention	266	225	248	229
Secondary prevention	128	119	162	132
Others	-	1	-	2
Implanting Centers[4]	6	6	6	*6*
Implanting Physicians[4]	~21	~26	~23	~24
National Registry[4]	☑	☑	☑	☑

Source: CGH, KTPH, NHCS, NTFGH, NUHCS, TTSH, SCDB as of 28 September 2022[4]

5. Lead Extraction

Lead extractions procedures and number of centers that performed lead extraction

	2018	***2019***	***2020***	***2021***
Total lead extraction procedures	47	49	53	49
Hospitals performed lead extraction	~6	~5	~4	~5

Cardiologists performing lead extraction	~16	~16	~14	~17
Surgeons performing lead extraction	-	~2	~2	~2
National Registry	☑	☑	☑	☑

Inclusive of Explantation / Replacement of PPM / ICD.

6. Interventional electrophysiology

	2018	***2019***	***2020***	***2021***
Ablation procedures[4]	**951**	**963**	**720**	**850**
SVT ablation procedures	-	-	-	-
AVNRT	193	206	162	193
AVRT/WPW	116	116	97	129
AFL (RA isthmus dependent)	205	198	156	165
AT	42	67	52	44
VT/VPC	128	152	90	151
Idiopathic	-	-	-	-
Structural	-	-	-	-
AF ablation procedures	244	193	143	146
Others	23	31	20	22
Ablation centers[4]	3	3	3	3
AF ablation centers	2	2	2	2
Structural VT ablation centers	2	2	2	2
Ablation physicians[4]	~20	~21	~19	~20
AF ablation physicians	–	–	–	-
Structural VT ablation physicians	–	–	–	-
National Registry[4]	☑	☑	☑	☑

Source: CGH, KTPH, NHCS, NTFGH, NUHCS, TTSH, SCDB as of 28 September 2022[4]

7. Management

National certification for physicians ☐PM ☐CRT ☐ICD ☐Ablation

National accreditation for centers	☑PM	☑CRT	☑ICD	☑Ablation
Guidelines followed	☐ National	☑U.S.	☑Europe	☐AP

Payment (%)	Pacemaker	ICD	CRT	Ablation
Government	-	-	-	-
Insurance	–	–	–	–
Public insurance	-	-	-	-
Private insurance	-	-	-	-
Individual	-	-	-	-

Obstacles to guideline implementation (1=no obstacle, 5=great obstacle)

	1	2	3	4	5
Lack of centers	☑	☐	☐	☐	☐
Lack of reimbursement, limited financial resources	☐	☐	☑	☐	☐
Lack of referral	☐	☐	☑	☐	☐
Lack of trained personnel	☐	☑	☐	☐	☐
Low awareness of guidelines	☐	☐	☑	☐	☐
Lack of operators	☐	☑	☐	☐	☐

8. Source

The source of information is contributed by the public hospitals i.e. Changi General Hospital, Khoo Teck Puat Hospital, National Heart Centre Singapore, Ng Teng Fong General Hospital, National University Hospital and Tan Tock Seng Hospital.

Country/Region: Sri Lanka

1. Statistics

	2018	2019	2020	2021
Population (thousand)[1]	21670		21803	21967
Hospitals	639		696	696
Beds	80980			
Physicians (MO s)	18679		19900	19900
Nurses	45930		-	
GDP (US$, billions)	88.22			285
Total expenditure on health as % GDP	1.97			
Government expenditure on health (US$)				
Insured citizens (%)	-			
SCD patients	-			
Heart failure patients	-			
AF patients	-			

8, www.census.gov

2. Pacemaker

	2018	2019	2020	2021
Total Pacemakers	2215		1700	1954
New implants	1463		1563	1657
Replacements	752		137	297
Single-chamber	1003		1207	996
Dual-chamber	460		493	561
Sick sinus syndrome	886		812	980
AV block	1329		888	974
Implanting Centers	11		14	14
Implanting Physicians	12		13	11
National Registry	□		–	–

3. Cardiac resynchronization therapy

	2018	2019	2020	2021
Total CRTs	34		43	35
CRT-P	22		35	25
CRT-P new implants	18		28	22

CRT-P replacements/upgrade	4		7	03
CRT-D	12		8	10
CRT-D new implants	11		7	09
CRT-D replacements/upgrade	1		1	01
Ischemic	9		11	13
Non-ischemic	23		32	22
Implanting Centers	6		9	07
Implanting Physicians	7		9	09
National Registry	☐		–	–

4. Implantable cardioverter defibrillator

	2018	2019	2020	2021
Total ICDs	83		202	285
ICD new implants	73		185	260
ICD replacements	8		17	25
Single-chamber	76		165	270
Dual-chamber	7		37	15
Primary prevention	-		123	143
Secondary prevention	-		79	142
Implanting Centers	8		13	09
Implanting Physicians	9		10	09
National Registry	☐		–	

5. Lead Extraction

Lead extractions procedures and number of centers that performed lead extraction

	2018	2019	2020	2021
Total lead extraction procedures	-		5	06
Hospitals performed lead extraction	-		3	03
Cardiologists performing lead extraction	-		-	
Surgeons performing lead extraction	-		2	06
National Registry	☐	☐	–	

6. Interventional electrophysiology

	2018	2019	2020	2021
Ablation procedures	891		658	478
SVT ablation procedures			361	349
AVNRT	401		267	226
AVRT/WPW	133		69	123
AFL(RA isthmus dependent)	10		10	
AT	01		15	03
VT/VPC	346		297	
Idiopathic	344		289	129
Structural	2		8	-
AF ablation procedures			-	-
Ablation centers	5		5	5
AF ablation centers	-		-	
Structural VT ablation centers	-		-	
Ablation physicians	7		9	9
AF ablation physicians			-	-
Structural VT ablation physicians			-	-
National Registry	☐			–

7. Management

National certification for physicians	☐PM	☐CRT	☐ICD	☐Ablation
National accreditation for centers	☑PM	☑CRT	☑ICD	☑Ablation
Guidelines followed	☐National	☑U.S.	☑Europe	☑AP

Payment (%)	Pacemaker	ICD	CRT	Ablation
Government				
Insurance				
Public insurance				
Private insurance				
Individual				

Obstacles to guideline implementation (1=no obstacle, 5=great obstacle)

	1	2	3	4	5

Lack of centers	☐	☐	☐	☑	☐
Lack of reimbursement, limited financial resources	☐	☐	☑	☐	☐
Lack of referral	☑	☐	☐	☐	☐
Lack of trained personnel	☐	☑	☐	☐	☐
Low awareness of guidelines	☐	☑	☐	☐	☐
Lack of operators	☐	☑	☐	☐	☐

8. Source

Individual Device Implantation and EP centers

Country/Region: South Korea (Republic of Korea)

1. Statistics

	2018	2019	2020	2021
Population (thousand)[1]	51164	51269	51780	51680
Hospitals[2]		-	40049	40862
Beds (per 100,000 population)[2]	1,240	-	1321	1398
Physicians (per 1,000 population)[2]	2.4	-	2.1	2.5
Nurses (per 1,000 population)[2]	7.3	-	4.3	8.8
GDP (US$, billions)[3]		1913.9	1933.1	2071.6
Total expenditure on health as % GDP[3]	-	8.0%	8.4%	8.8%
Government expenditure on health as %[3]		4.9%	5.2%	5.6%
Insured citizens (%)	100	100	100	100
SCD patients				
Heart failure patients				
AF patients				

1, www.census.gov

2, www.who.int / http://apps.who.int/nha/database/country_profile/Index/en

3, www.imf.org

2. Pacemaker

	2018	2019	2020	2021
Total Pacemakers	5408	4368	4285	5153
New implants	4457		3497	3805
Replacements	951			951
Single-chamber	-		620	834
Dual-chamber	-		3006	3500
Sick sinus syndrome	-		1682	2040
AV block	-		2089	2519
Implanting Centers	-		56	60
Implanting Physicians	84		109	114
National Registry	☒		☒	

3. Cardiac resynchronization therapy

	2018	2019	2020	2021

Total CRTs	272	352	346	409
CRT-P	-		58	61
CRT-P new implants	-		31	31
CRT-P replacements/upgrade	-		22	31
CRT-D	-		284	290
CRT-D new implants	-		176	211
CRT-D replacements/upgrade	-		67	81
Ischemic	-		58	76
Non-ischemic	-		229	261
Implanting Centers	-		50	51
Implanting Physicians	62		89	90
National Registry	☒		☒	

4. Implantable cardioverter defibrillator

	2018	2019	2020	2021
Total ICDs	1542	1248	1146	1135
ICD new implants	1366		896	868
ICD replacements	176		116	122
Single-chamber	-		564	426
Dual-chamber	-		456	450
Primary prevention	-		491	475
Secondary prevention	-		576	499
Implanting Centers	-		56	59
Implanting Physicians	76		103	110
National Registry	☒		☒	

5. Lead Extraction

Lead extractions procedures and number of centers that performed lead extraction

	2018	2019	2020	2021
Total lead extraction procedures	92	113	125	135
Hospitals performed lead extraction	12		19	24
Cardiologists performing lead extraction	31		71	74

Surgeons performing lead extraction	2		21	32
National Registry	☒		☒	

6. Interventional electrophysiology

	2018	2019	2020	2021
Ablation procedures	9545	9631	10348	11554
SVT ablation procedures	5040	4936	4636	5124
AVNRT	-		1992	1915
AVRT/WPW	-		1379	1171
AFL (RA isthmus dependent)	-		1030	1233
AT	506		359	386
VT/VPC	461	671	975	615
Idiopathic	-		447	420
Structural	-		106	115
AF ablation procedures	3538	4024	4977	5796
Ablation centers	40			
AF ablation centers	37	45	49	17
Structural VT ablation centers	17	19	16	17
Ablation physicians	66			
AF ablation physicians	54		88	98
Structural VT ablation physicians	42		80	85
National Registry	☑		☒	

7. Management

National certification for physicians	☐PM	☐CRT	☐ICD	☐Ablation
National accreditation for centers	☐PM	☐CRT	☐ICD	☐Ablation
Guidelines followed	☑National	☐U.S.	☐Europe	☐AP

Payment (%)	Pacemaker	ICD	CRT	Ablation
Government				

Insurance				
Public insurance				
Private insurance				
Individual				

Obstacles to guideline implementation (1=no obstacle, 5=great obstacle)

	1	2	3	4	5
Lack of centers	☑	☐	☐	☐	☐
Lack of reimbursement, limited financial resources	☐	☐	☑	☐	☐
Lack of referral	☐	☐	☑	☐	☐
Lack of trained personnel	☐	☑	☐	☐	☐
Low awareness of guidelines	☐	☐	☑	☐	☐
Lack of operators	☐	☑	☐	☐	☐

8. Source

KHRS (Korean Heart Rhythm Society)

Country/Region: Taiwan, CN

1. Statistics

	2018	2019	2020	2021

Population (thousand)[1]	23590	23574	23561	23195
Hospitals[2]	473	476	472	473
Beds[2]	148947	168,266	151,862	138,442
Physicians[3]	46356	49,542	51,045	52,175
Nurses[3]	159621	154,747	160,795	183,253
GDP (US$, billions)[4]	589.391	611,255	669,321	668,321
Total expenditure on health as % GDP[5]	6.1			
Government expenditure on health as %[6]		6.54	6.69	
Insured citizens (%)	99%	99%	99%	99%
SCD patients				
Heart failure patients				
AF patients				

[1]https://www1.stat.gov.tw/np.asp?ctNode=4649&mp=3
[2]https://dep.mohw.gov.tw/DOS/cp-1735-3246-113.html
[3]https://dep.mohw.gov.tw/DOS/cp-1735-3245-113.html
[4]https://www1.stat.gov.tw/point.asp?index=1#
[5]https://iiqsw.mohw.gov.tw/InteractiveIntro.aspx?TID=9FBD55607C91A331
[6]https://dep.mohw.gov.tw/DOS/lp-2156-113.html

2. Pacemaker

	2018	2019	2020	2021
Total Pacemakers	6735	6904	6990	7038
New implants	85%	82%	81%	5711
Replacements	15%	18%	19%	1327
Single-chamber (Leadless included)	23%	22%	18%	1401
Leadless	1.7%	1.3%	1.3%	147
Dual-chamber	77%	78%	82%	5637
Sick sinus syndrome	55%	63%	55%	3518
AV block	45%	37%	45%	2980
Implanting Centers	112	110	116	292
Implanting Physicians	552	550	349	946
National Registry	☑	☑	☑	☑

3. Cardiac resynchronization therapy

	2018	2019	2020	2021
Total CRTs	312	354	315	321
CRT-P	227	216	223	240
CRT-P new implants	70%	60%	67%	122
CRT-P replacements/upgrade	30%	40%	33%	118
CRT-D	85	138	92	81
CRT-D new implants	71%	43%	53%	34
CRT-D replacements/upgrade	29%	57%	47%	47
Ischemic	34%	40%	32%	140
Non-ischemic	66%	60%	68%	181
Implanting Centers	52	35	54	98
Implanting Physicians	122	120	123	178
National Registry	☑	☑	☑	☑

4. Implantable cardioverter defibrillator

	2018	2019	2020	2021
Total ICDs	816	891	864	812
ICD new implants	80%	77%	76%	592
ICD replacements	20%	23%	24%	220
Single-chamber	44%	39%	36%	277
Dual-chamber	56%	61%	64%	535
Primary prevention	2%	1.5%	0.6%	13
Secondary prevention	98%	98.5%	99.4%	799
Implanting Centers	82	58	71	190
Implanting Physicians	234	175	178	294
National Registry	☑	☑	☑	☑

5. Lead Extraction

Lead extractions procedures and number of centers that performed lead extraction

	2018	2019	2020	2021
Total lead extraction procedures	55	14	26	35
Hospitals performed lead extraction	6	8	2	12
Cardiologists performing lead extraction	44	12	12	26
Surgeons performing lead extraction	11	2	12	9
National Registry	☑	☑	☑	☑

6. Interventional electrophysiology

	2018	2019	2020	2021
Ablation procedures	5069	5020	5501	5254
SVT ablation procedures	2514	2507	2923	2473
AVNRT	1757	1804	1530	1401
AVRT/WPW	740	722	624	593
AFL (RA isthmus dependent)	621	632	666	691
AT	158	171	246	226
VT/VPC	1056	1115	1021	1013
Idiopathic	676	810	889	755
Structural	135	125	212	119
AF ablation procedures	1241	1142	1185	1282
Ablation centers	38	38	73	18
AF ablation centers	15	15	22	16
Structural VT ablation centers	15	15	22	7
Ablation physicians	94	98	78	60
AF ablation physicians	67	70	65	69
Structural VT ablation physicians	66	69	57	60
National Registry	☐			

7. Management

National certification for physicians	☐ PM	☐CRT	☑ ICD	☑ Ablation
National accreditation for centers	☐ PM	☐CRT	☐ICD	☐ Ablation
Guidelines followed	☑ National	☑ U.S.	☑ Europe	☑ AP

Payment (%)	Pacemaker	ICD	CRT	Ablation
Government				
Insurance				
Public insurance				
Private insurance				
Individual				

Obstacles to guideline implementation (1=no obstacle, 5=great obstacle)

	1	2	3	4	5
Lack of centers	☑	☐	☐	☐	☐
Lack of reimbursement, limited financial resources	☐	☐	☐	☑	☐
Lack of referral	☑	☐	☐	☐	☐
Lack of trained personnel	☑	☐	☐	☐	☐
Low awareness of guidelines	☑	☐	☐	☐	☐
Lack of operators	☑	☐	☐	☐	☐

8. Source

Taiwan Heart Rhythm Society

Country/Region: Thailand

1. Statistics

	2018	2019	2020	2021
Population	69,282,825	69,828,393	67,921,857	69,950,850
Hospitals			1356	1344
Beds(per 100,000 population)			245 beds/100,000 Or Bed: Population = 1:415	229 beds/100,000 or 1:389
Physicians			Physician: Population =1:1674	1:1680
Nurses			Nurse: Population =1:379	1:353
GDP (US$)		$543.65 billion	$512 billion	$505 billion
Total expenditure on health as % GDP				
Government expenditure on health as %			1.7% (Gov Expenditure on Health 343,906 mil Baht; GDP 16,898,086 mil Baht)	
Insured citizens (%)		87.9	99.3%	99.3%
SCD patients				
Heart failure patients			Inpatient with heart failure Dx: 216,131 Or 3/1000 pop	
AF patients				

Total Pacemakers	3863	3827	4509	3954
New implants	3301	2802	3498	2923
Replacements	562	1025	1011	1031
Single-chamber	1160	1138	1133 + 25 Micra	1637+21 MICRA
Dual-chamber	2633	2711	3351 (74.3%)	2139
Sick sinus syndrome				
AV block				
Implanting Centers		25 (government)		26 (government)
Implanting Physicians				
National Registry				

3.Cardiac resynchronization therapy

	2018	2019	2020	2021
Total CRTs	384	373	429	399
CRT-P				
CRT-P new implants	50	62	43	50
CRT-P replacements/upgrade	20	33	39	36
CRT-D				
CRT-D new implants	234	177	255	233
CRT-D replacements/upgrade	80	101	92	80
Ischemic				
Non-ischemic				
Implanting Centers		25 (government)		26 (government)
Implanting Physicians				
National Registry				

4. Implantable cardioverter defibrillator

	2018	2019	2020	2021
Total ICDs	949	952	1110	
ICD new implants	820	750	930	752

ICD replacements	129	202	180	138
Single-chamber	809	805	880 + 20 SICD	669+7 SICD
Dual-chamber	148	225	216	205
Primary prevention				
Secondary prevention				
Implanting Centers		25 (government)		26 (government)
Implanting Physicians				
National Registry	☐			

5. Lead Extraction

Lead extractions procedures and number of centers that performed lead extraction

	2018	2019	2020	2021
Total lead extraction procedures	42	23	43	68
Hospitals performed lead extraction	5	7	7	13
Cardiologists performing lead extraction				68
Surgeons performing lead extraction				0
National Registry	☐			

6. Interventional electrophysiology

	2018	2019	2020	2021
Ablation procedures				
SVT ablation procedures				
AVNRT	1158	1135	1060	897
AVRT/WPW	667	372	347	476
AFL (RA isthmus dependent)	181	184	279	188
AT	116	138	125	148
VT/VPC				
Idiopathic	384	479	526	435
Structural	10	16	31	26
AF ablation procedures	131	177	188	187RF + 16Cryo
Ablation centers	18	25 (government)		

AF ablation centers		25 (government)	12	12
Structural VT ablation centers			12	12
Ablation physicians				
AF ablation physicians				
Structural VT ablation physicians				
National Registry	N/A			

7. Management

National certification for physicians	☑PM	☑CRT	☑ICD	☑Ablation
National accreditation for centers	☐PM	☐CRT	☑ICD	☐Ablation
Guidelines followed	☑National	☑U.S.	☑Europe	☑AP

Payment (%)	Pacemaker	ICD	CRT	Ablation
Government	100% except MICRA (20%)	100%	100%	100% except Cryo (30%)
Insurance				
Public insurance				
Private insurance				
Individual				

Obstacles to guideline implementation (1=no obstacle, 5=great obstacle)

	1	2	3	4	5
Lack of centers	☐	☐	☑	☐	☐
Lack of reimbursement, limited financial resources	☐	☐	☐	☑	☐
Lack of referral	☐	☐	☐	☑	☐
Lack of trained personnel	☐	☑	☐	☐	☐
Low awareness of guidelines	☐	☐	☐	☑	☐
Lack of operators	☐	☑	☐	☐	☐

8. Source

Country/Region: Vietnam

1. Statistics

	2018	2019	2020	2021
Population (thousand)[1]	96,452		97,338	98,510
Hospitals	-			
Beds	-			
Physicians	-			
Nurses	-			
GDP (US$, billions)	241		271	362.64
Total expenditure on health as % GDP	-			
Government expenditure on health (US$)	-			
Insured citizens (%)	87.7			
SCD patients	-			
Heart failure patients	-			
AF patients	-			

9' www.census.gov

2. Pacemaker

	2018	2019	2020	2021
Total Pacemakers	3242	4891	2042	3351
New implants	2594			
Replacements	648			
Single-chamber	1450	1876		1118
Dual-chamber	1792	2641		2233
Sick sinus syndrome	2107			
AV block	1135			
Implanting Centers	44	46	46	46
Implanting Physicians	120	126	130	135
National Registry				

3. Cardiac resynchronization therapy

	2018	2019	2020	2021

Total CRTs	94	111	104	85
CRT-P	54	49	73	61
CRT-P new implants	48			
CRT-P replacements/upgrade	6			24
CRT-D	40	62	32	
CRT-D new implants	35			
CRT-D replacements/upgrade	5			
Ischemic	-			
Non-ischemic	-			
Implanting Centers	14	14	14	14
Implanting Physicians	30	30	30	30
National Registry				

4. Implantable cardioverter defibrillator

	2018	2019	2020	2021
Total ICDs	192	263	263	216
ICD new implants	168			
ICD replacements	24			
Single-chamber	170		219	198
Dual-chamber	22		44	8
Primary prevention	154			
Secondary prevention	38			
Implanting Centers	18	18	18	18
Implanting Physicians	40	40	40	40
National Registry				

5. Lead Extraction

Lead extractions procedures and number of centers that performed lead extraction

	2018	2019	2020	2021
Total lead extraction procedures	-		1	1
Hospitals performed lead extraction	-		1	1
Cardiologists performing lead extraction	-		1	1
Surgeons performing lead extraction	-			

National Registry				

6. Interventional electrophysiology

	2018	2019	2020	2021
Ablation procedures	3483	4042	2947	
SVT ablation procedures				
AVNRT	1729	1656	785	
AVRT/WPW	804	902	835	
AFL (RA isthmus dependent)	49	40	29	
AT	129	100	57	
VT/VPC	1343	1289	1064	
Idiopathic	1343		1064	
Structural	0			
AF ablation procedures	101	55	106	
Ablation centers	21	22	22	
AF ablation centers	7	7	7	
Structural VT ablation centers	4	4	4	
Ablation physicians	45		45	
AF ablation physicians	14	16	16	
Structural VT ablation physicians	7		9	
National Registry				

7. Management

National certification for physicians	☑PM	☑CRT	☑ICD	☑Ablation
National accreditation for centers	☑PM	☑CRT	☑ICD	☑Ablation
Guidelines followed	☑National	☑U.S.	☑Europe	☐AP

Payment (%)	Pacemaker	ICD	CRT	Ablation
Government				
Insurance				
Public insurance				
Private insurance				

Individual				

Obstacles to guideline implementation (1=no obstacle, 5=great obstacle)

	1	2	3	4	5
Lack of centers	☐	☑	☐	☐	☐
Lack of reimbursement, limited financial resources	☑	☐	☐	☐	☐
Lack of referral	☑	☐	☐	☐	☐
Lack of trained personnel	☐	☑	☐	☐	☐
Low awareness of guidelines	☑	☐	☐	☐	☐
Lack of operators	☐	☐	☑	☐	☐

8. Source

Vietnam Heart Rhythm Society: Ton That Minh, MD., Pham Tran Linh, MD. Vien Hoang Long, MD., at al

The APHRS White Book: Tenth edition

-The current status of cardiac electrophysiology in APHRS member countries

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President of APHRS

1. Foreword

The White Book of Asia Pacific Heart Rhythm Society (APHRS) is an annual compilation of the cardiac electrophysiology data from APHRS member countries and regions from 2013. As in previous years, the APHRS white book provided valuable update information about current status of activity in the field of arrhythmia treatment encompassing country demographics, epidemiology of cardiac arrhythmia, implantation of CIEDs (pacemaker, cardiac resynchronization therapy, and implantable cardioverter defibrillator), procedures of interventional electrophysiology, and obstacles to guideline implementation etc. Under the joint effort of our board members, the tenth edition of APHRS White Book was finally released with data from 18 countries and regions, including China mainland, Hong Kong CN, India, Indonesia, Japan, Korea, Malaysia, Myanmar, New Zealand, Philippines, Singapore, Taiwan CN, Thailand, Vietnam, Brunei Darussalam,Cambodia,Mongolia, and-Sri Lanka. The Data collection is mostly the result of voluntary participation of each national Society of Pacing and Electrophysiology or national Heart Rhythm Society. We hope the APHRS White Book will become a key reference for those seeking information about electrophysiological procedures and CIEDs in Asia-Pacific countries.

2. Methodology

A primary research was conducted within national Heart Rhythm Societies or working groups of cardiac pacing and electrophysiology of each country. Each chairman of the societies and/or working groups was asked to compile information about their country for the year 2021 based on a questionnaire. Secondary research has been conducted with the help of reliable official online databases to cross verify the information reported here. Three major source of

information have been used: healthcare data were extracted from the World Health Organization (WHO) (http://www.who.int), whereas demographic information were taken by the United States Census Bureau International Database (http://www.census.gov), and finally, the source of economic information has been the International Monetary Fund (IMF) World Economic Outlook Databases (http://www.imf.org). A total of 18 APHRS member countries and regions provided their data in this edition. The analysis was performed on the trend of device implantation and catheter ablation from 2018 to 2021, and the device implantation rates or catheter ablation rates and centers in 2021.

3. Permanent Pacemaker Implantation

3.1 Increase in pacemaker implantation

As shown in Figure 1, the increasing trend in the implantation of permanent pacemaker was seen in 10 countries or regions in 2021 as compared with 2020. For Vietnam, the implantation of pacemaker demonstrated a significant increasing rate at 60.68%. The pacemaker implantation in China Mainland, Hong Kong, India, Mongolia, South Korea, Scro Lanka and Vietnam show an increasing rate over 10%. Reported data showed decreased pacemaker implantation over 10% in Brunei, Indonesia, Malaysia, Philippines and Thailand.

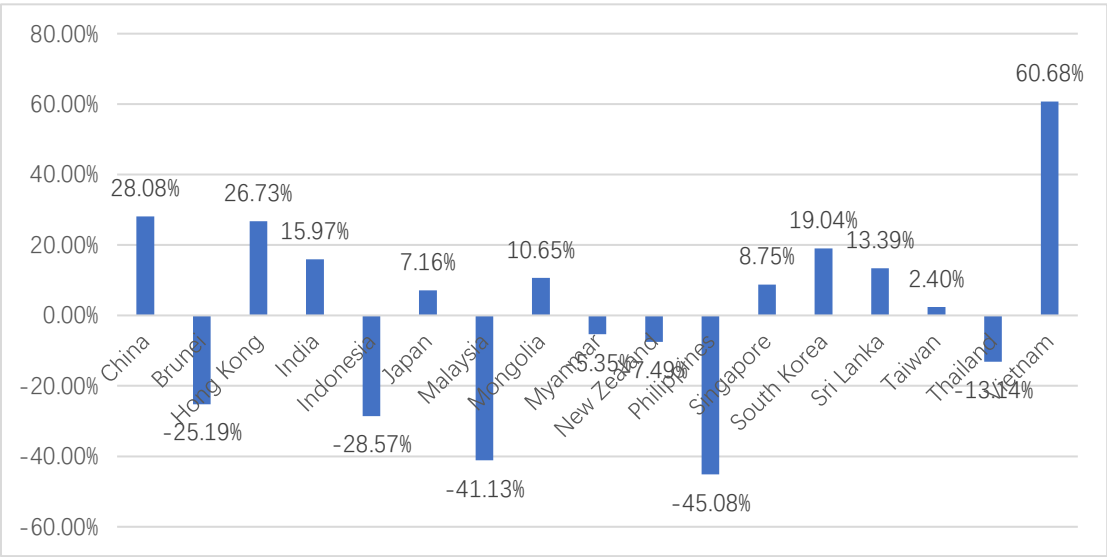

Figure 1: Increasing rate of pacemaker implantation in 2021 as compared with 2020

3.2 Pacemaker implantation rate

As shown in figure 2, data in 2021 were analyzed by evaluating pacemaker implantation rates. Across the 18 countries or regions, the pacemaker implantation rate per million inhabitants showed a different trend to that in last year with Japan(544.51) overtakes Singapore(501.00) as country with highest pacemaker implantation rate in Asia and the lowest in Philippines (4.63). The pacemaker implantation rates per million inhabitants were also low in Indonesia (4.90) and Myanmar (8.94). The large gap in the number of pacemaker implanting center per million inhabitants still remained among the 18 countries and regions. In 2021, Taiwan remianed as the top region where had the same highest implanting centers per million inhabitants (12.59), while the second with high pacemaker implanting centers per million inhabitants were Brunei(4.42). Other countries remained similar level to that in 2020. Although the reported data in 2021 did not differ significantly from that in 2020, our analysis still found a significant change as compared with several years before. One major difference from last year is that pacemaker implantation rate was shown an increased trend in more than half of Asia-Pacific countries and regions. Other data provided similar information. For example, China and Japan are still the countries that had the highest total number of pacemaker implantations in 2021. The influence of GDP on pacemaker implants did not differ as compared with that in 2020. The countries with highest GDP per capita of the 18 countries and regions were Hong Kong, New Zealand, Japan, and Taiwan. The countries with highest implantation rate per million inhabitants were also New Zealand, Japan, Taiwan and Hong Kong.

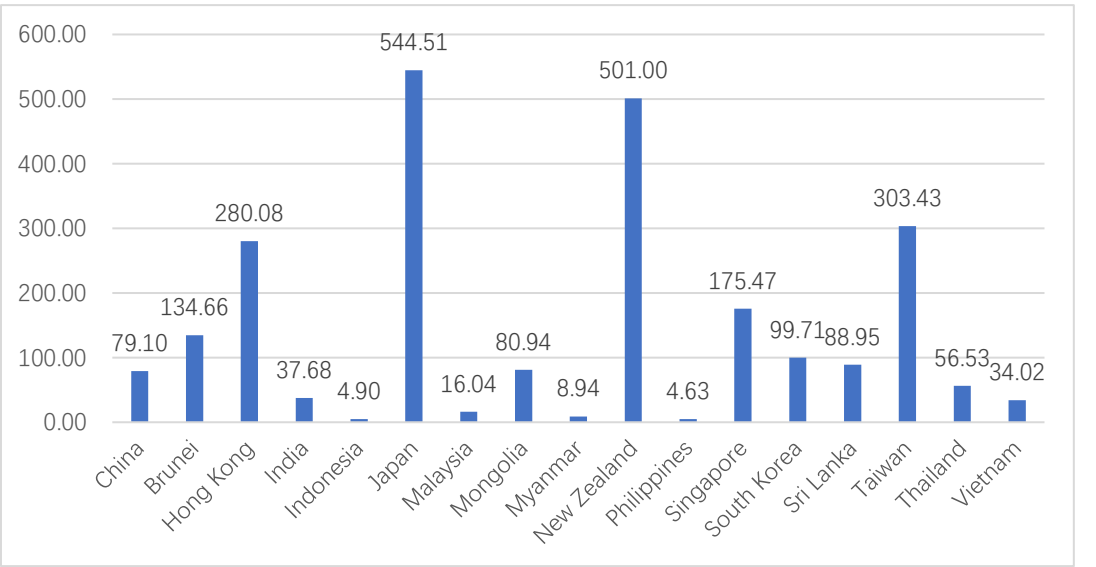

Figure 2 Pacemaker implantation rate/ million inhabitants in 2021

4. ICD and Cardiac Resynchronization Therapy devices (CRT)

4.1 The implantation of ICD in 2020

Unlike data last year, the decreasing trend of implantation of ICD was observed in 10 APHRS countries and regions in 2021 as compared with 2020, and only 6 APHRS countries and regions showed increasing trend (Figure 3). Most Asia-Pacific countries and region showed an decreasing trend in ICD implantation. Japan, China and India are the three countries that had the highest total number of pacemaker implantations in 2021. The countries with the decrease rates of ICD implant more than 30% in 2021 were Malaysia(-51.58%), Myanmar(-32.25%), Phillipines (-53.26%). China had an increasing trend of 68.27% in ICD implantation. The ICD implantation was still rare in some Asia-Pacific countries like Mongolia (4 cases).

We also analyzed the data on ICD primary or secondary prevention from 10 countries and regions: China mainland, India, Philippines, Taiwan, Indonesia, Singapore, Malaysia, Myanmar, Brunei, and Mongolia. The use of ICD for primary prevention in Singapore, Brunei, Myanmar and Philippines were higher than 50% (63.09%, 62.96%, 60.00%, and 57.14% respectively). China mainland and Indonesia had a primary prevention ratio of ICD more than 30% (39.01%, 34.85% respectively). Singapore was the country having the highest ratio of primary prevention in Asia-Pacific countries and regions (63.09%).

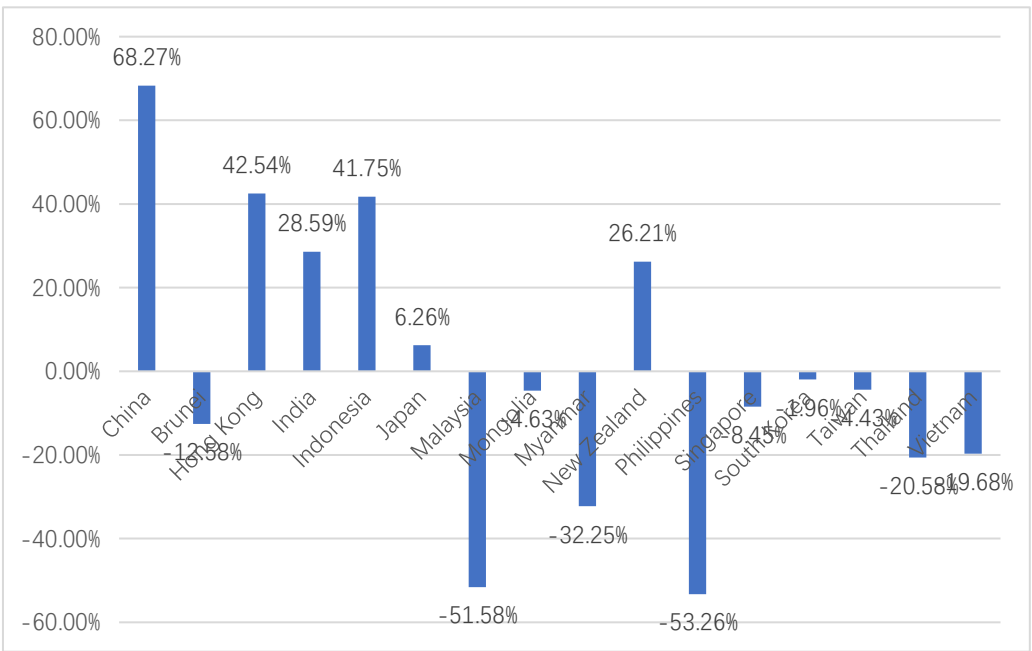

Figure 3: Increasing rate of ICD implantation in 2021 as compared with 2020

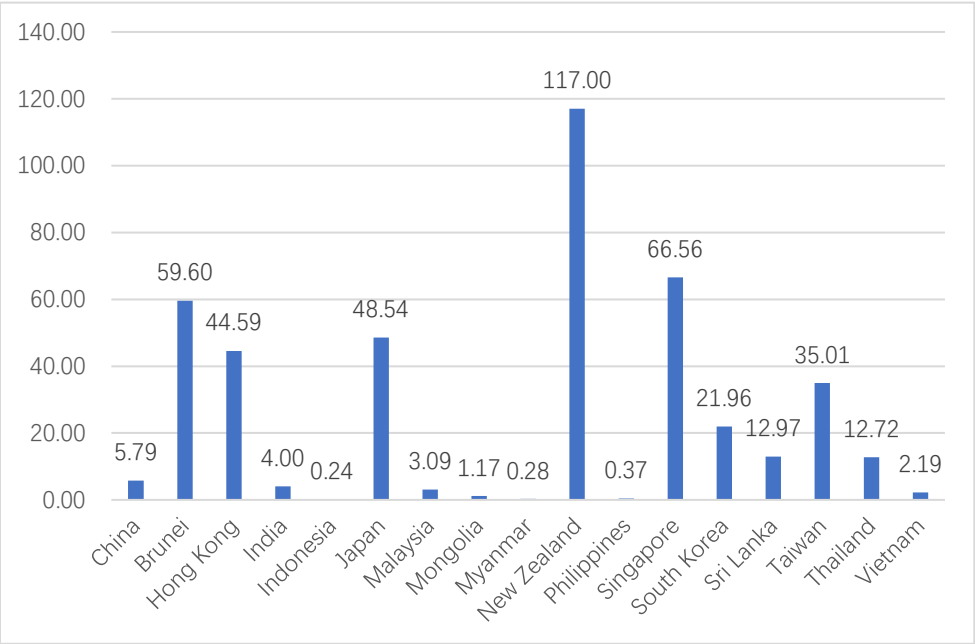

Figure4: ICD implantation rate/ million inhabitants in 2020

4.2 ICD implantation rate

As shown in Figure 4, New Zealand was still the country with highest reported ICD implantation rate per million inhabitants (117.00). Singapore(66.56), Brunei (59.60) and Japan (48.54) were the other countries with high ICD implants/million. Some countries kept increasing ICD implants/million, including Singapore and Thailand. Countries with low ICD implants/million were Philippines (0.37), Myanmar (0.28) and Indonesia (0.24). The available data also showed a large gap among the 18 countries and regions in the number of ICD implanting center per million inhabitants. In 2021 data, the countries with more than 1 ICD implanting centers per million inhabitants were Brunei (4.5), Taiwan (3.5), New Zealand (1.6), and Singapore (1.1). The other countries and regions with less than 1 implanting centers per million inhabitants included India (0.8), Indonesia(0.1), Malaysia (0.2), Mongolia (0.3), Myanmar (0.1), Sri Lanka (0.4), Philippines (0.1), Mainland China (0.3), and Vietnam (0.2).

4.3 CRT utilization in Asia-Pacific area

In 2021, we had data on CRT implantation from 17 Asia-Pacific countries and regions (Figure 5). The rising trend in CRT implantation remains in 7 among the data from 17 countries and regions, there were 10 countries and regions which showed decreased CRT implantation.

In 2021, the countries with total number of CRTs implantation more than 1000 were Mainland China (5956), Japan (5543) and India (4106), and those with CRT implantation between

100 and 1000 were Hong Kong (184), Thailand (399), New Zealand (339), Singapore (172), South Korea (409) and Taiwan (321). The countries with the increase rates of CRT implant more than 10% in 2020 were China(51.21%), Indonesia(11.28%), India(40.00%) and South Korea(17.07%). And the countries and regions with a decrease rate over 10% in CRT implantation included Brunei(-20.53%), Malaysia(-64.95%), Mongolia(-18.54%),-Philippines (-48.07%), and Vietnam(-20.11%). The total number of CRT implant was also relatively low in 4 countries and regions, including Mongolia(6), Philippines (14), Brunei (18), and Myanmar (1), although some of them had been demonstrated as an increasing trend.

The CRT implantation rate per million inhabitants in 2021 seemed to be decreased as compared to last year, and a great heterogeneity was seen similar to last year, from as low as 0.02-1/million (Myanmar, Indonesia, Philippines and Vietnam) to as high as 68/million in New Zealand, 44 in Japan, 40 in Brunei and 32 in Singapore. The decreasing trend was seen in the CRT implantation rate per million inhabitants in most Asia-Pacific countries and regions, including Brunei (from 50.0 in 2020 to 39.74 in 2021), Malaysia (from 5.4 in 2020 to 1.9 in 2021), Philippines (from 0.2 in 2020 to 0.1 in 2021), and there was a slightly increasing trend in China (from 2.79 in 2020 to 24.46 in 2021), India (from 2.08 in 2020 to 2.91 in 2021), South Korea(from 6.76 in 2020 to 7.91 in 2021).

There was also significant variability in the ratio of CRT-D/CRT-P implants. The number of "CRT implant centers" in 15 countries and regions were analyzed. 9 out of 15 Asia-Pacific countries and regions were with more than 50% CRT-D implantation rate, in which Brunei was shown with the highest CRT-D/total CRT ratio (88.89%). CRT-D implantation rate above 50% were shown in other 8 countries and regions, including Philippines(85.71%), Hong Kong(80.43%), Thailand(78.45%), Singapore(77.33%), Malaysia(74.60%), Japan(70.32%), China(68.79%), India(59.86%).

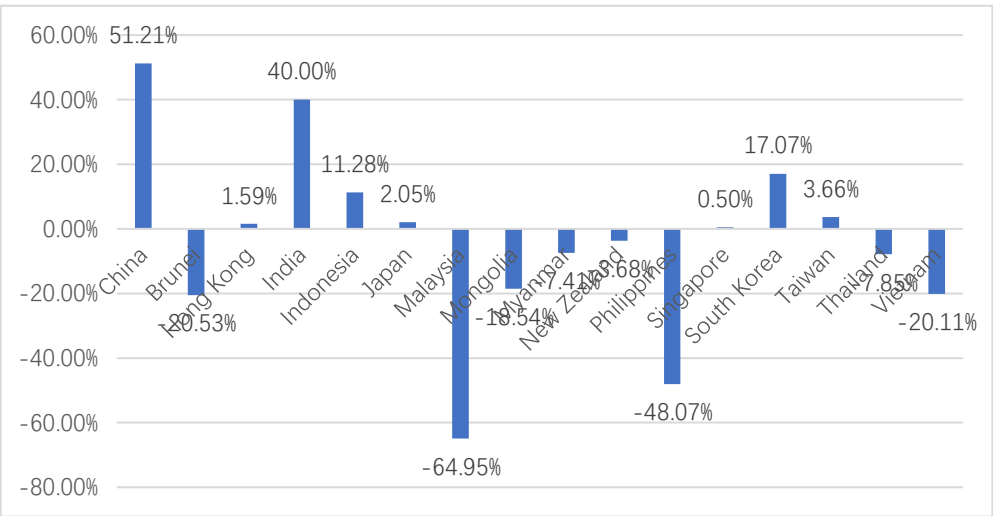

Figure 5: Increasing rate of CRT implantation in 2020 as compared with 2019

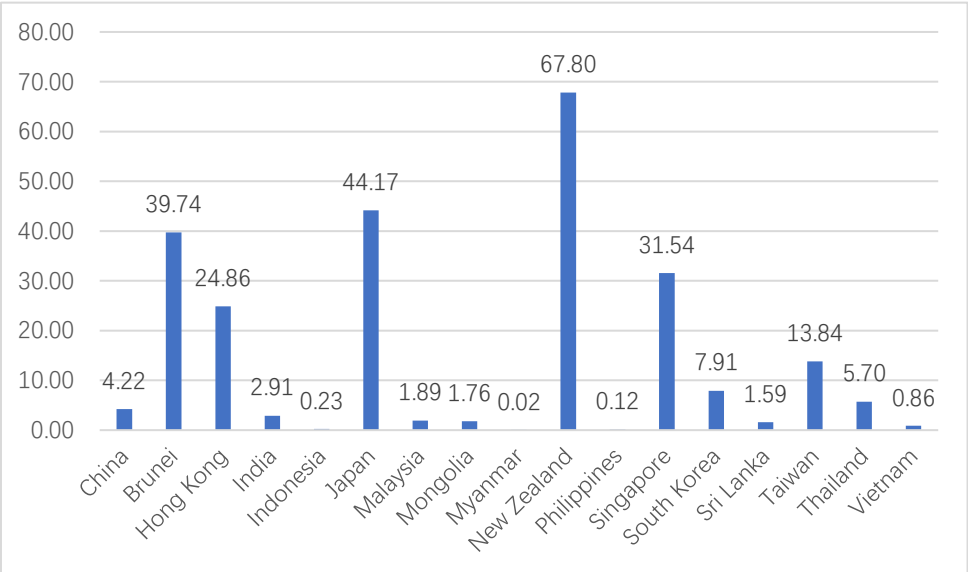

Figure 6: CRT implantation rate/ million inhabitants in 2020

5 Catheter Ablation

5.1 General information of Catheter Ablation

We received data about catheter ablation from 15 countries and regions in 2021. China mainland was still the country having the highest cases receiving catheter ablations (210609). Japan was the other countries with high cases of 102781, and South Korea 11554 . The ablation procedures in other countries and regions were less than 10000. An increasing trend was observed in ablation procedures across 10 countries. India was the country with the highest ablation increasing rate (74.71%). There were 4 countries and regions with an increasing rate more than 30%, including Philippines (65.22%), Hong Kong(38.26%), China Mainland(34.25%) and Indonesia(33.11%). The increasing rate in Japan(2.78%) was relatively low as compared with other countries. However, Taiwan(-4.49%), New Zealand(-32.73%), Malaysia(-44.22%) and Myanmar(-50.75%) demonstrated decrease in catheter ablation.

5.2 Ablation procedure rates

Table 2 is shown the ablation procedures per million inhabitants in 18 countries and regions. Japan was the country which continued having increasing ablation procedures per million inhabitants, from 632.4 in 2018 to 758.9 in 2019, 790.5 in 2020, and 819.0 in 2021. China also has increased ablation procedures per million inhabitants (from 112.4 to 149.2). Countries

having more than one hundred ablation procedures per million inhabitants included Mainland China (149.2), Singapore (155.8), Brunei (225.2), South Korea(223.6), and Taiwan (226.5). Philippines(1.0) Indonesia(4.3) and India(5.9) had the lowest ablation procedures per million inhabitants. In China mainland, the ablation procedures/ million inhabitants increased from 108.6 in 2018 to 124.7 in 2019, decreased to 112.4 in 2020 and increased to 149.2 in 2021. Regarding ablation centers per million inhabitants in 2021, the highest density was remained in Japan (5.98) and the lowest in Indonesia (0.08) and Philippines (0.09).

5.3 Atrial fibrillation (AF) catheter ablation

With missing data on the number of AF ablation procedures in Pakistan this year, we had the data of AF ablation from 14 countries and regions this year. In 2021, AF ablation procedures increased almost in all countries. China became the country with the highest number of AF ablation procedures (87994 cases). As shown in Table 2, the AF ablation rate per million inhabitants was increased from 40 to 62.33 in China. India (0.12), Philippines (0.04) and Indonesia(0.31) were the countries with the lowest AF ablation rate. Regarding the ratio of AF ablation/total ablation, there was also a large gap among 14 countries and regions, with highest ratio of AF ablation/total ablation in Japan (74.60%), and lowest AF ablation ratio in India(2.10%). And the AF ablation ratio was 41.78% in China, 7.13% in Indonesia, 14.68% in Malaysia, 31.02%in New Zealand, 3.51% in Philippines, 17.18% in Singapore, 50.16% in South Korea, 24.40% in Taiwan and 8.55% in Thailand.

6 Conclusion and future work

This edition of APHRS White book had made a great progress with collection of data from 18 APHRS countries and regions although some data were not available. Primary analysis of these data showed a growing trend in arrhythmia interventional treatment in part of Asia-Pacific countries and regions, and some of countries and regions presented decreased CIED implantation and catheter ablation rate . There is still a great gap between Asia and Western countries. These data also highlight significant inequalities covering all arrhythmia interventional therapies in Asia-Pacific countries. The overview of these data indicated that more supervision, cardiac education training and guideline implementation are needed to promote the development of arrhythmia interventional therapy. The APHRS White Book needs indispensable support and participation of all member countries in Asia-Pacific regions. The APHRS White book may serve as motivation for these countries to adopt a systematic approach to key data on arrhythmia therapy in the future.

Table 1. The CIEDs implantation rates and implanting centers per million inhabitants for the year 2021 in 18 Asia-Pacific countries and regions

Countries and regions	Pacemaker implantation rate/ million inhabitants	Pacemaker implanting centers / million	ICD implantation rate/ million inhabitants	CRT implantation rate/ million inhabitants	ICD/CRT implanting centers / million
PR. China	79.1	0.7	5.8	4.2	0.3
Brunei	135	4.4	59.6	40.0	4.4
Cambodia	No data	No data	No data	No data	No data
Hong Kong	280.1	No data	44.6	24.9	No data
India	37.7	0.8	4.0	2.9	0.8
Indonesia	4.9	0.2	0.2	0.2	0.1
Japan	544.5	No data	48.5	44.2	No data
Malaysia	16.0	1.5	3.1	1.9	0.2
Mongolia	81.0	0.9	1.2	1.8	0.3
Myanmar	8.9	0.2	0.3	0.02	0.1
New Zealand	501.0	2.8	117	67.8	1.8
Philippines	4.6	0.6	0.4	0.1	0.1
Singapore	175.5	1.1	66.6	31.5	1.1
South Korea	99.7	1.2	22.0	7.9	1.1
Sri Lanka	89.0	0.64	13.0	1.6	0.4
Taiwan	303.4	12.6	35.0	13.8	12.4
Thailand	56.5	0.4	12.7	5.7	0.4
Vietnam	34.0	0.5	2.2	0.9	0.2

Table 2 The ablation procedure rate and centers per million inhabitants for the year 2021 in 18 Asia-Pacific countries and regions

Countries and regions	Ablation procedure rate/ million inhabitants	Ablation centers/ million inhabitants	AF ablation rate/ million inhabitants	AF ablation centers/ million inhabitants	AF ablation/ ablation procedure（%）
PR. China	149.2	1.19	62.33	0.55	41.78
Brunei	225.2	4.42	94.92	2.21	42.16
Cambodia	No data	No data	No data	No data	No data

Hong Kong	122.5	No data	No data	No data	No data
India	5.9	0.11	0.12	0.01	21.00
Indonesia	4.3	0.08	0.31	0.05	7.13
Japan	819.0	5.98	610.94	4.38	74.60
Malaysia	17.4	1.41	2.55	0.09	14.68
Mongolia	33.1	0.29	No data	0.29	No data
Myanmar	5.5	0.11	No data	0.02	No data
New Zealand	276.6	3.00	85.80	1.60	31.02
Philippines	1.0	0.09	0.04	0.04	3.51
Singapore	155.8	0.55	26.77	0.37	17.18
South Korea	223.6	0.66	112.15	0.33	50.16
Sri Lanka	21.8	0.23	No data	No data	No data
Taiwan	226.5	0.78	55.27	0.69	24.40
Thailand	33.9	0.34	2.90	0.17	8.55
Vietnam	No data	No data	No data	No data	No data

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