



## 10 Years of Pacemaker Implantation in Port Harcourt, Rivers State: Our Experience and Matters Arising

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### Abstract

**Background:** *There has been an increasing growth in the number of pacemaker implantations in Nigeria. This study is aimed at reviewing the pattern and occurrence of pacemaker implantation and also mode of pacemaker over a 10-year period.*

**Methods:** *We retrospectively reviewed patients who underwent pacemaker implantation over a 10 year period between September 2012 and December 2023.*

**Results:** *During the study period, 41 patients underwent pacemaker implantation. There were more males (51.2%) than females with a general mean age  $66.8 \pm 10.6$ . The most common indication was Complete heart block (CHB) (60.98%) followed by second degree atrioventricular block (27.27%). There was an increasing trend in the rate of pacemaker implantation over the 10 years in review. There was no significance difference in the rate of complication between the genders.*

**Conclusion:** *Pacemaker implantation in Port Harcourt south-south, Nigeria started in September 2012. The major reason for pacemaker implantation were complete heart block (CHB) and second degree Atrioventricular block (2<sup>nd</sup> degree AVB) being the second reason. Sick sinus syndrome (SSS) was rare in our population as opposed to the western world. Pacemaker implantation is being widely accepted in our society and it is lifesaving procedure associated with very low risk.*

**Keywords:** *Pacemaker, Pacemaker implantation, heart block, Port Harcourt.*

### Introduction

Over 700,000 pacemakers are implanted each year worldwide, with over 250,000 occurring in the United States.<sup>(1)</sup> In Western Europe, there are 140 Cardiac resynchronization therapy (CRT) devices and 938 bradycardia pacemakers implanted per million people each year.<sup>(2)</sup> Because pacemaker implantation is not commonly performed and

individuals purchase their pacemakers, the public in underdeveloped nations like Nigeria and most African countries is not well exposed to pacemakers.<sup>(3,4)</sup> The average pacemaker implantation rate in Nigeria as of 2018 was 0.2 per million per year, one of the lowest among Africa countries.<sup>(5)</sup> 80.5% of Nigerian patients in need of pacemakers rely on charitable donations

to pay for their devices acquisition and installation. When used appropriately, pacemakers are costly devices without many alternatives.<sup>(3)</sup>

Patients with bradycardia, such as those with second- or third-degree atrioventricular block, significant sinus node dysfunction, tachycardia-bradycardia syndrome, bundle branch block with a history of syncope, and, under certain conditions, in different disease states, should consider permanent pacemaking, per guidelines.<sup>(6)</sup> This invasive surgery sometimes comes with a number of short- or long-term problems.<sup>(7)</sup> Up to 4-5% of individuals have early difficulties, whereas 2.7% of cases have late issues. The major causes of complications are either factors connected to the surgery (such as hematoma, lead dislodgement, absence of antibiotic prophylaxis, etc.) or features specific to the device (such as abdominal pocket, epicardial leads, etc.).<sup>(8,9)</sup>

One (VVI or AAI) or two (DDD) leads fixed in the right side of the heart make up a transvenous pacemaker system; a CRT device adds a separate lead on the left side. A pacemaker device, measuring 50 x 50 mm, with a thickness of 5-7 mm and a weight of 20-30 g, is connected to the lead(s). The device is usually implanted on the left side, beneath the collarbone. Perforation, damage to the tricuspid valve, and persistent arrhythmias are among the perioperative problems that might arise during lead fixation in the cardiac wall and during vascular access (pneumothorax, artery puncture, and nerve plexus injury).<sup>(2,10,11)</sup>

There is lack of infrastructure and human resource available for the management of cardiac arrhythmias in sub-Saharan Africa.<sup>(3,4,12)</sup> The primary causes of the underutilization of interventional arrhythmia therapy in Africa continue to be the extremely low density of highly qualified physicians, the absence of facilities and financial resources, the high expenses associated with pay-out-of-pocket healthcare, and the dearth of fellowship programs.<sup>(4,12)</sup>

The need for lifelong therapy following pacemaker implantation is widely established.

Consequently, clinic follow-up schedules and procedures should be established prior to hospital discharge and adjusted based on the requirements of individual patients or the device.<sup>(9)</sup>

This study is aimed at reviewing the pattern and occurrence of pacemaker implantation and also mode of pacemaker over a 10-year period. This study also assessed the gender differences in clinical feature of the pacemaker patients.

## Material and Methods

### Study Population

This is a retrospective study of all patients who received pacemaker implantation at the University of Port Harcourt Teaching Hospital and Goodheart Medical Consultant Hospital, Port Harcourt over a 10-year period between 2013 and 2023. This study consisted of 41 patients aged between 50 and 92 years.

### Data variables

The data collected from the hospital record for each patient included: demographic characteristics (e.g. gender, age, education level, etc.), clinical characteristics (e.g. age of implantation, type of pacemaker, etc.) and other characteristics as reported by patients.

### Statistics

Numeric data were described as frequencies, percentages and means (standard deviation [SD]), and percentiles. All scores on the questionnaire were reported in numbers. Tests of differences in results between subgroups were performed using the chi square test. All statistical tests were two-sided with a significance level of 0.05. The database in Excel 2020 (Microsoft Corporation) was imported for analyses using STATA version 15.0.

## Results

Forty-one patients who underwent cardiac device implantation were included. The mean age of the study population was  $66.8 \pm 10.6$ . The ages of the subject ranged from 50 to 87 years. Of these subjects 51.2% were male and 48.8% were

female. Single chamber (VVIR) pacemaker device was the most common mode of implantation and was seen in 61% of the subjects (Table 1).

The trend of pacing across the 10 years period shows and increasing trend. The first year (2012) has only 2 pacemakers implanted in the facility. The year with the highest rate of implantation was 2022 with 9 patients, it decreased a little to 7 patients in 2023 (Fig 1).

The distribution of type (mode) of pacemaker device across the years shows single and double chamber devices use as 50% each for the year 2012, 100% of the devices use from 2013 to 2019 were single chambers, then in 2020, 75% of the devices were double chambers. In 2022 and 2023 the majority of the devices use were double chambers 66.67% and 85.71%, respectively.

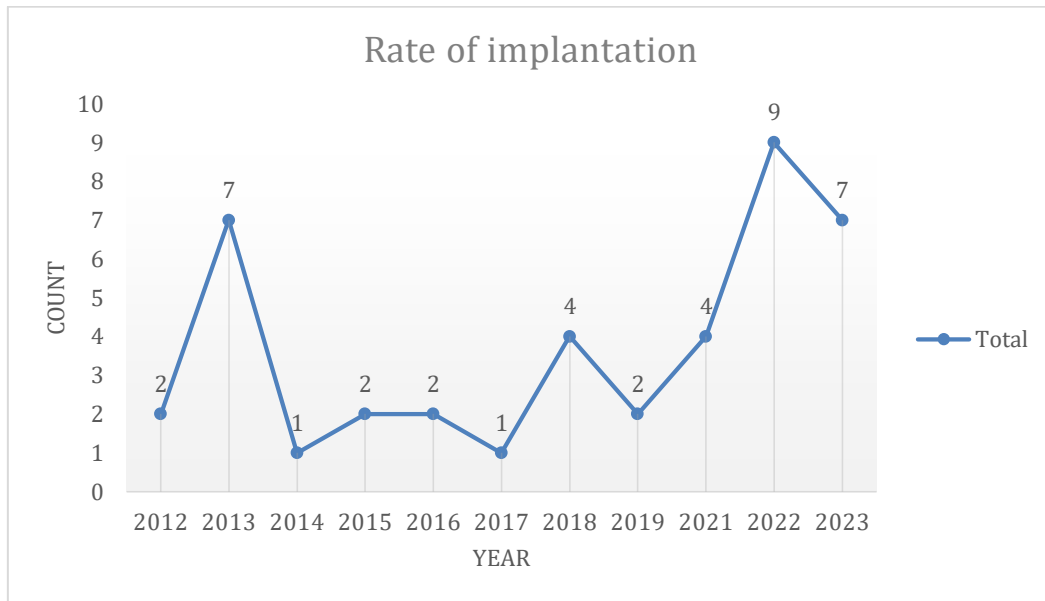
The most used pacemaker device manufacturer was Medtronic (Minneapolis Minnesota USA) in 22 patients (53.7%), St Jude (St Paul Minnesota USA) was used in 19 patients (43.3%) (Tabel 1). Trend in type of device used according to years shows that in the first year (2012) 50% each of Medtronic and St Jude devices were used. There was decline in use of Medtronic from 2013 to 2017 while St Jude was mostly used during this period. In 2018 75% of devices used were Medtronic while 25% was St Jude. From 2021 to 2023 Medtronic was mostly used with frequency of 100%, 66.67% and 100% for 2021, 2022 and 2023, respectively (Fig 2).

The mean age of female and male patients with pacemaker were  $72.36 \pm 11.1$  versus  $73.48 \pm 11.4$ , respectively ( $P = 0.089$ ). Dizziness was the most common symptom, occurring more in male (57.1% of males) than in female (55.0%). The most common comorbidity found in theses subject were hypertension (HTN) and diabetes mellitus (DM). 95% of female and 85.7% of male subjects were hypertensive ( $p$  value = 0.317) while 30% of female and 28.7% of male had DM. The major indication was complete heart block (CHB) (55% for female and 66.7% for male). Second degree

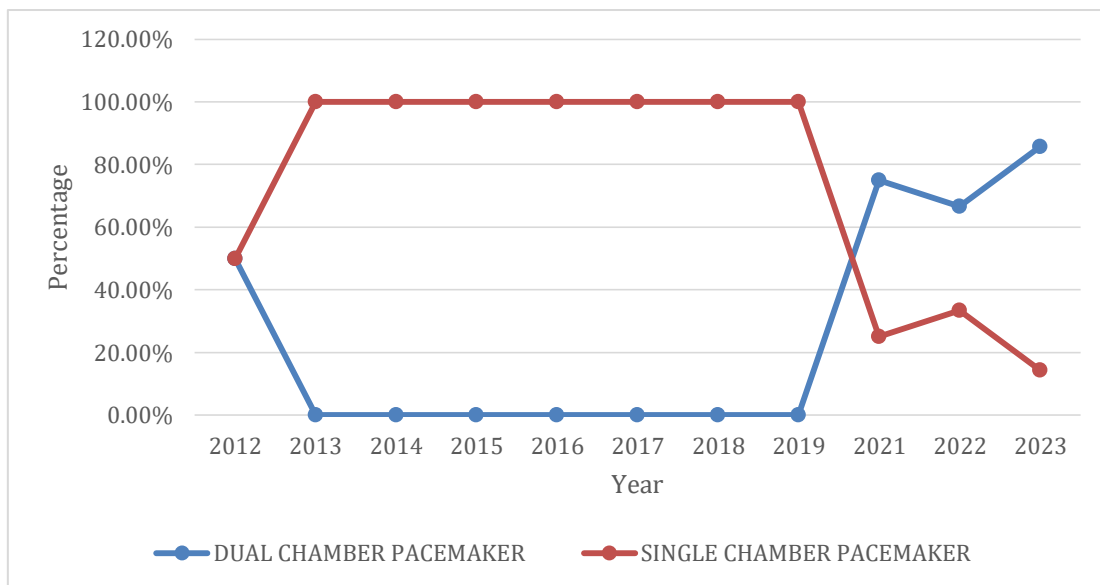
atrioventricular block (AVB) were more in female (30% of female) than male (28.6% of male). Female patients had more of the other indications compared with male patients (15% for female and 4.8% for male). There was no statistically significant difference between indication for pacing and gender. Majority of the subjects had no pacing related complications. Pocket infection and expulsion was noted in 5% and 4.8 of female and male, respectively (Table 2).

**Table 1:** Baseline characteristics of the patients

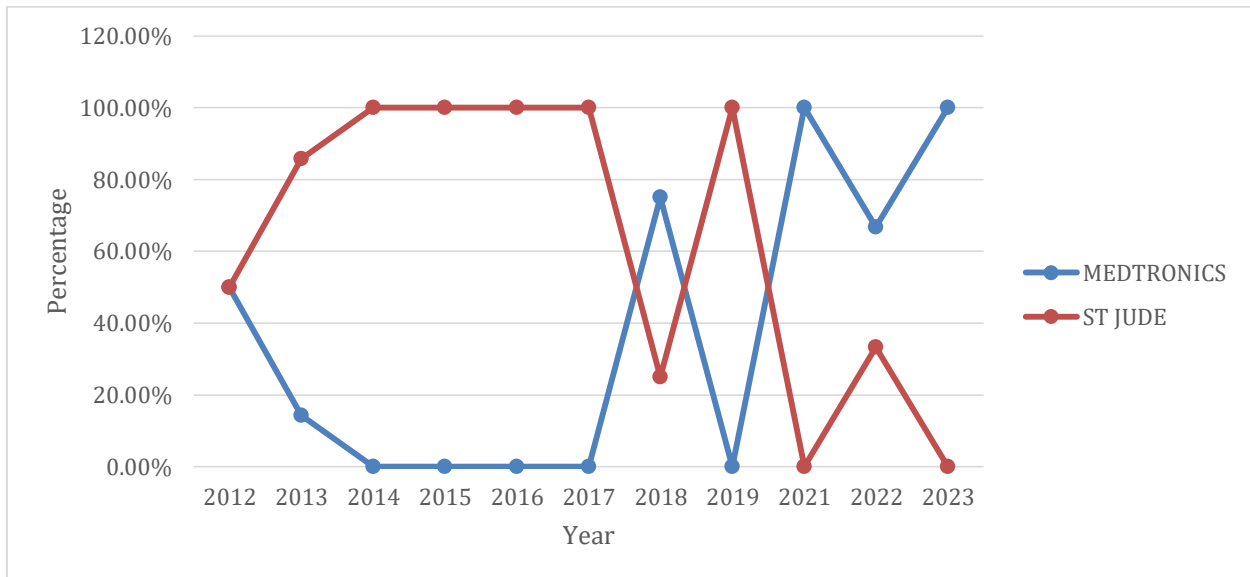
Variable	Number (%)
Number of patients	41
Mean age (years)	$66.8 \pm 10.6$ (range = 50 – 87 years)
Mean heart rate	$32.6 \pm 4.5$
Males	21 (51.2)
Females	20 (48.8)
<b>Age group (years)</b>	
50 – 60	14 (34.1)
61 – 70	12 (29.3)
71 – 80	9 (22)
>80	6 (14.6)
<b>Pacemaker type</b>	
Single chamber (VVIR)	25 (60.98)
Double chamber (DDDR)	16 (39.02)
<b>Device Manufacturer</b>	
Medtronic	22 (53.7)
St Jude	19 (43.3)
<b>Indication</b>	
CHB	25 (60.98)
2 <sup>nd</sup> Degree AVB	12 (27.27)
Others	4 (7.76)



**Fig 1:** Trend of pacing according to years



**Fig 2:** Trend in pacing mode according to years

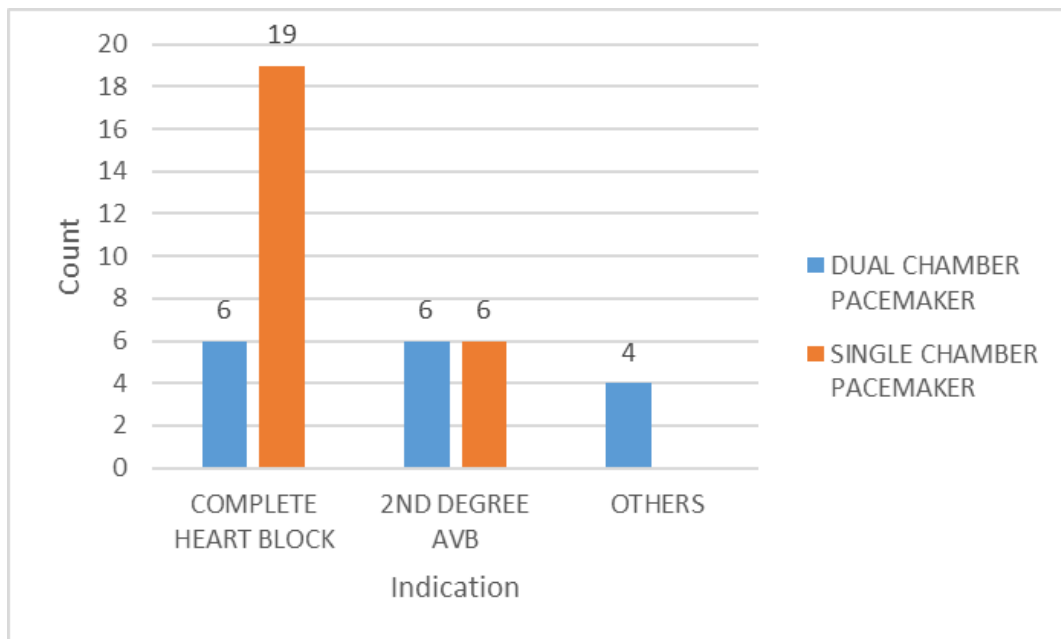


**Fig 3:** Trend in type of device used according to years

**Table 2:** Clinical features of pacemaker implanted patients according to gender

	Female	Male	P Value
Age, years (%)	64 ±10.6	69.52 ±9.8	0.089
<b>Symptoms</b>			
Dizziness (%)	11 (55.0)	12 (57.1)	0.890
Blackout (%)	6 (30.0)	4 (19.1)	0.414
Dyspnea (%)	5 (25.0)	3 (14.3)	0.347
Palpitation (%)	1 (5.0)	2 (9.5)	0.578
Syncope (%)	1 (5.0)	5 (23.8)	0.089
Weakness	4 (20.0)	2 (9.52)	0.343
<b>Comorbidities</b>			
HTN	19 (95.0)	18 (85.7)	0.317
DM	6 (30.0)	6 (28.7)	0.920
PUDX	3 (15.0)	0	0.065
HF	0	2 (9.5)	0.157
COPD	1 (5.0)	1 (4.8)	0.972
CKD	1 (5.0)	1 (4.8)	0.097
KCS	1 (5.0)	0	0.300
CAP	0	2 (9.5)	0.157
Stroke	2 (10.0)	1 (4.8)	0.302
CVD	0	1 (4.8)	0.290
BPH	0	2 (9.5)	0.157
Glaucoma		1 (4.8)	0.290
<b>Indications</b>			0.513
CHB	11 (55.0)	14 (66.7)	
Second degree AVB	6 (30.0)	6 (28.6)	
Others	3 (15.0)	1 (4.8)	
<b>Complications</b>			0.419
Pocket infection & expulsion	1 (5.0)	1 (4.8)	
Pocket necrosis & expulsion	1 (5.0)	0	
Lead dislodgment	0	1 (4.8)	
None	13 (65.0)	13 (61.9)	

HTN = hypertension; DM = Diabetes mellitus; PUDX = Peptic ulcer disease; HF = heart failure; COPD = chronic obstructive pulmonary disease; CKD = Chronic kidney disease; KSC = Keratoconjunctivitis sicca; BPH = benign prostatic hyperplasia; CHB = Complete heart block; AVB = Atrioventricular block



**Fig 4:** Distribution of Implants by indication and mode

**Discussion**

There are ten known pacemaker implant centers in Nigeria at the moment. According to a personal statistics, there are three centers in Lagos and one each in Enugu, Ibadan, Abuja, Port Harcourt, Calabar, Ife, and Ilorin.<sup>(13)</sup> Pacemaker implantation started in Port Harcourt in 2012 by Nwafor and his team, since then we have experienced an upward trend in rate of implantation (Fig 1).

The present study was conducted to assess the pattern and occurrence of pacemaker implantation and also mode of pacemaker implantation in Port Harcourt south-south Nigeria over a 10-year period. In the present study, 41 patients underwent permanent pacemaker implantation over the period in review. A higher proportion of these patients were in the 50 – 60 age group, followed by the 60 – 70 age group. Single chamber pacemaker devices were mostly implanted, though double chamber device were the most commonly used in the facility in recent years (Fig 2).

The mean age in this study was 66.8 years with 51.2% being male and 48.8% female. This is similar to an analysis of a 5-year experience done in Lagos, Nigeria on 51 patients and noted the mean age to be 68 years with 56.9% being male

and 43.1% female.<sup>(13)</sup> This is within the 65–75 year age range that was reported in the 11th World Survey on implanted cardioverter-defibrillators and cardiac pacing.<sup>(14)</sup> Also, the 11th World Survey revealed that, in line with our findings, more men than women (55% vs. 45%) are getting implants.

According to the experience by Thomas from Lagos, 100 patients had implants between 1999 and 2004. The patients' average age was 62 years, 93% were female, 86% had been diagnosed with congenital heart block, and 89% of them had single chamber ventricular pacing while 11% had dual chamber pacing. There were no issues noted.<sup>(15)</sup> The experience from Enugu in a series of 23 implants performed between 2001 and 2006 noted the mean patient age was 70 years, 65% of patients had CHB, 65% of cases used endocardial leads, and 35% of cases used epicardial leads.<sup>(16)</sup> There is also a published experience in 2018 from Turkey in a large population of 452 pacemaker implanted patients between 2006 and 2016 which found the proportion of female to be almost equal to male (female 49.9%, male 50.1%).<sup>(17)</sup> A 2003 study from Dakar Senegal of 92 implants over a 3 year period showed an equal male to female ratio

and 87% of implants done were single chamber ventricular pacing.<sup>(18)</sup>

Most patients in this study were diagnosed with CHB (60.98%) which is similar to other West African<sup>(13,19,20)</sup> and Asian studies<sup>(21,22)</sup> as the most common indication for pacing. However, this is in contrast to the trend observed in the Western World, where the primary indication for cardiac pacing is sinus node dysfunction (SND) and less than 30% of patients present with CHB.<sup>(14)</sup> Among the patients who underwent implantation for others reasons, one experienced device failure after the procedure, another needed a pacemaker replacement, a third patient had a pacemaker generator changed, and a fourth patient developed sick sinus syndrome (SSS).

All patients in our series had permanent pacemaker and none had temporary pacemaker as their first implant similar to a series of 51 patient in Lagos State, Nigeria where only 1 patient had a temporary pacemaker implanted.<sup>(13)</sup> This result, however, contradicts another earlier experience from Lagos, where 6 patients needed temporary pacing as a stopgap measure before permanent pacemaker implantation since there were delays in procuring the pacemaker.<sup>(23)</sup> Temporary pacemaker is implanted when the permanent pacemaker is not readily available as noted earlier before the present time where we now have pacemaker manufacturers' representatives in Nigeria. It was recommended<sup>(24)</sup> that if a permanent pacemaker is available right away, there is no need to implant a temporary one.

In our experience, single chamber pacemaker devices were majorly used but in the later years there was a progressive decline in the use of single chamber devices in turn resulting to progressive increase in dual chamber device use. In the 1990s, dual chamber pacing was recommended due to hemodynamic benefits, leading to improved longevity, quality of life, and stroke reduction, with randomized controlled trials showing its advantages.<sup>(25,26)</sup> Age had an impact on pacing mode selection, whereas gender had no such

effect, according to studies which also showed that the number of DDD pacing systems implanted decreased with age.<sup>(17,27)</sup> The initial reason for selecting the VVI pacing mode could be the evidence that VVI pacing was found to be superior to DDD pacing in patients with bradycardia. The frequency of complication due to devices did not differ based on gender ( $P = 0.419$ ). The rates of mechanical complications were equal in both male and female patients (Table 2). A previous study showed that the gender of the patient is linked to a higher risk of acute problems following pacemaker implantation.<sup>(28)</sup>

Our experience noted 4 complications at the rate of 9.8% which is higher than 5.8% observed in a large prospective randomized controlled study and 1.5% in a series of 1,286 implants in the UK<sup>(29,30)</sup>. A study in Lagos noted a higher rate where they found 10 out of 51 patients had complications.<sup>(13)</sup> An earlier study in Lagos noted no single complication in 100 implants over a 5-year period.<sup>(23)</sup> The higher rate of complication in this study could be attributed to a more detailed follow up compared to others. Our study also noted majority of the complications are associated with single chamber devices unlike in a study in Lagos<sup>(13)</sup> where all the complications occurred with double chamber devices. This questions the assertion that there is a higher complication rate with dual chamber implants.<sup>(31)</sup>

### Conclusion

Our study has shown an increase in the rate of pacemaker implantation due to improved acceptance and awareness of the procedure. All the patients were above the age of 50 and gender-specific differences did not significantly influence the cardiac device implantations, pacing modes, and patients' demographics over the 10-year period. The patients' quality of life and symptoms improved following pacemaker implantation for symptomatic bradycardia. Thus, for individuals with symptomatic bradycardia, pacemaker

implantation is the only safe, effective therapeutic option with relatively low adverse events.

According to our research, patients in Nigeria felt comfortable having their pacemaker devices inserted and replaced locally rather than traveling abroad. Pacemaker implantation is also valued in Nigeria. While there is industrial discontent, public hospitals should increase their expenditure in invasive cardiac treatments.

### Ethical

Ethical approval was duly obtained from the Ethical Committee of the University of Port Harcourt Teaching hospital.

### Acknowledgment

The authors acknowledge the support of the nurses, research personnels and ICT staff in collecting the data for this study.

### Funding:

This study received no external funding.

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