

## REVIEW

# Counseling Patients with Implanted Cardiac Devices: the Nurse's Role

Dimitra Angelidou, RN

*First Department of Cardiology,  
Evangelismos General Hospital, Athens,  
Greece*

**KEY WORDS:** *pacemaker, implantable  
cardioverter-defibrillator, nursing care*

## ABSTRACT

Patients with implanted cardiac devices constitute a growing segment of the contemporary healthcare practice. Taking care of such a rapidly growing patient population constitutes a challenge for all health care providers working in a cardiology ward, operating or procedure room, or primary care practice. Nurses among them have a unique role by being the most appropriate persons to provide in-hospital and long-term health care, education and psychological support to these patients. In-hospital and long-term care will ensure an uneventful procedure and a safe discharge as well as early detection of device malfunction and late complications. Education of the patient will prevent any self or environmental interactions which can adversely affect proper device function and will increase his or her adherence to the follow-up treatment. Finally, by providing psychosocial and emotional support the nursing staff can address the immediate concerns of the patient and help him or her cope successfully with the new life situation. Continuing education is extremely important for nurses counselling patients with implanted devices in order to play successfully their role as the continuous link to the multidisciplinary team of professionals that guide the oftentimes forgotten humanistic care of these patients.

## INTRODUCTION

Patients with implanted cardiac devices constitute a growing segment of the contemporary healthcare practice. According to the American Heart Association, more than 170,000 pacemakers and 30,000 implantable cardioverter-defibrillators (ICDs)<sup>1</sup> are implanted in the United States each year. Since there were released the results of the Multicenter Automatic Defibrillator Implementation Trials (MADIT I and II), which found ICD treatment superior to drug therapy alone for the treatment of ventricular arrhythmias, the number of implantations of ICDs has quadrupled.<sup>2,3</sup> In fact, pacemakers with biventricular pacing capability, many of them combined with ICD function, are now being implanted for New York Heart Association Class III and IV heart failure patients aiming to improve their quality of life and increase their life expectancy.<sup>4</sup> A recent study which pooled data from three trials of 1,080 patients found that cardiac resynchronization (biventricular pacemaker-based therapy) decreased the risk of death from progressive heart failure (often sudden death from lethal arrhythmias) or cardiac transplantation compared to the control group by 59%.<sup>5</sup>

## ABBREVIATIONS

EMI = electromagnetic interference  
ICD = implantable cardioverter  
defibrillator

*Correspondence to:*  
Dimitra Angelidou, RN  
Efroniou 77  
Athens, Greece  
Tel: 6937-509919

Similarly, recent data from the registry of the European Heart Rhythm Association have shown that, despite the fact that ICDs are underused in Europe, device implantation rate exhibits an increased trend in most European countries over the last few years.<sup>6</sup> Taking care of such a rapidly growing patient population constitutes a challenge for all health care providers working in a cardiology ward, operating or procedure room, or primary care practice. Nurses among them have a unique role by being the most appropriate persons to provide in-hospital and long term health care, education and psychological support to these patients. In this review we will present briefly some of the aspects of the nurse's role as counselors of patients receiving an implantable cardiac device.

---

**IN-HOSPITAL AND LONG-TERM CARE OF  
PATIENTS WITH IMPLANTED DEVICES.  
THE NURSE'S ROLE**

---

The preoperative, intraoperative and postoperative care is similar for all patients regardless of which type of implantable cardiac device they receive. In the case of an elective procedure, typically a generator replacement, the patient is admitted for an overnight stay. On the other hand, in case of a first-time implantation the patient may have already spent several days in the hospital undergoing invasive and non-invasive diagnostic tests (like coronary angiogram, electrophysiology study, tilt-table test or Holter monitoring) before the criteria for a device implantation have been met. Under these circumstances, nurses have the valuable role to closely monitor patient's vital signs and clinical status. This type of close monitoring will allow early detection of abnormalities preoperatively, like hematomas or occult infections at the intravenous line sites or excess fluid retention in patients with heart failure, which have to be thoroughly treated before the procedure. In addition, nurses should be kept responsible for the meticulous preparation of the patient for the operating or procedure room inserting the appropriate lines and administering chemoprophylaxis and sedation. Knowledge of these medication dosages and adverse effects is also mandatory.<sup>7</sup> In the procedure room nurses assist the physicians and coordinate the operating room tasks performed by the medical team. They assist initially by placing monitors, starting IV lines and positioning. They also scrub in to pass instruments and assist the operator as well as circulating duties that include charting during the case, monitoring the patient and communicating with both nurses and physicians in the cardiology ward and in the cardiac care unit to coordinate the best care for the patient.<sup>8</sup> Postoperative nurse monitoring is even more important since it will allow early detection of surgical complications like hematoma, infection, dysrhythmias, pneumothorax and hemothorax. The continuation of prophylactic antibiotic coverage for at least 24 hours following devices insertion should also be part of the

post-implantation nursing care.<sup>9</sup>

The role of a pacemaker nurse as a member of the follow-up pacemaker clinic has been established in most European countries and the USA. A pacemaker nurse is directly involved in the patient follow up evaluation, i.e. history taking, patient examination and use of the equipment for analysis of the device function, which include 12-lead electrocardiography with and without magnet, radiography, ambulatory and transtelephonic electrocardiographic monitoring, and pacemaker programmers.<sup>10</sup> Specific training in this very demanding field is required for the pacemaker nurses to accomplish their duties successfully and regular re-training to keep up to date with the rapidly evolving changes in the device technology seems also mandatory.

Beyond the highly specialized role of a pacemaker nurse, any nurse working in a primary health care setting should be familiar with at least some general aspects of the pacemaker patients' follow-up care and provide counselling to this patient population. For the long-term follow up, patients who have a pacemaker or an ICD should always be encouraged to carry the manufacturer's identification card with them at all times. In this card as well as in the medical record the following information must be documented: (a) the manufacturer of the device, (b) the model number, (c) the serial number, (d) implant date, (e) mode of operation, (f) programmed parameters (output, rate, sensitivity), (g) upper and lower rate limits for rate responsive devices, (h) type of lead fixation (active or passive), (i) unipolar or bipolar lead system, (j) ICD capability (shock, pacing, both), and (k) type of delivery system for ICD shocks (epicardial or transvenous lead system). At each clinic visit, the nurse should inquire about symptoms indicative of arrhythmias, heart failure, and/or ischemia, as well as device complications such as the development of dizziness, syncope, palpitations, chest pain, and shortness of breath. The patient should be specifically queried about arm swelling and increased warmth on the side ipsilateral to implantation of the endovascular leads, and redness or swelling at the device pocket.

Reported cardiac device infection rates vary between 2% and 8%. Treatment typically involves the removal of all implanted hardware, in addition to long-term antibiotic therapy.<sup>11</sup> Patients should always be questioned about ICD discharges (shocks) that have occurred between visits, however it is not uncommon for ICDs to reach end-of-life without ever delivering a shock for a clinical event. The nurse should be aware and inform the other clinic staff that there is no danger to them if they come in contact with a defibrillator patient during an active ICD discharge. Unintended effects of antiarrhythmic drugs can deplete generator life and lead to device malfunctioning, such as firing for sinus tachycardia or atrial fibrillation with a rapid ventricular response. Electrolyte imbalances, including hyperkalemia or hypokalemia, alter the heart's electrical response and must be avoided. Nurses who are taking care of patients with implanted cardiac devices who are also taking

antiarrhythmic drugs, need to monitor drug and electrolyte levels on a regular basis (every 2 to 3 months). Finally, it is a nurse's duty to ensure that a chest radiograph is obtained post-implantation of either a pacemaker or ICD to document baseline location and condition and that it should be repeated on an annual basis or whenever a lead fracture, lead dislodgement, or migration is suspected.

---

#### TEACHING A PATIENT WITH AN IMPLANTED CARDIAC DEVICE

---

Ideally, patient teaching should start preoperatively and include the patient's family and caregivers. Education is essential for a cardiac device recipient and guidelines for nursing care have already been published. The underlying assumption is that the patient will process and understand the information received to help him/her to adapt his/her life with a device. While recovery from these procedures is generally uncomplicated, patients need to learn beforehand how to avoid putting tension or stress on the leads so that they stay in place. The nurse is responsible for instructing the patient to keep the arm on the side of the device in a sling for the first day postoperatively, even while he sleeps, to completely immobilize it. The patient should also be instructed that for four to six weeks after the implant procedure, he/she should not raise the affected arm over the head, lift anything with it, or do any activity that requires abrupt, forceful arm movements.<sup>12</sup> Another aspect of teaching is to make the patient aware about potential complications. He/she should be told to seek care immediately if he/she experiences chest pain or shortness of breath. He/she should call his/her physician if he/she develops swelling of the hands, arms, legs, ankles, or feet, or sudden weight gain, such as 1.5 kilograms overnight or up to 3 kilograms over two or three days. These signs and symptoms could indicate, among other things, worsening heart failure, which could also mean that the device is not functioning properly.<sup>13</sup> Nurses should explain how to spot signs of infection and tell the patient to call the physician if the surgical site becomes red, warm, or has drainage, or if he/she develops fever.

The nurse taking care of a patient with an implanted device makes sure that patient receives the proper identification card and carries it in his person all the time. Patients should be instructed to show this card to security personnel at airports and anywhere where they might have to go through a metal detector, and to healthcare professionals before routine exams and during emergency care.

*Electromagnetic interference (EMI)* is another issue patients need to be counseled on. The nurse has to be familiar with the relevant information to communicate it to the patient. Electromagnetic interference is defined as "highly-regular electrical potentials of low amplitude and high frequency." Experts feel that sources of EMI must be in close proximity

(within 1.5 meters) to the patients' devices in order to interfere with cardiac device functioning. Sources carrying the highest probability levels of interference with cardiac devices include: arc welding equipment, electronic muscle stimulators, radio transmitters, concert speakers, large motor-generator systems, electric drills, and hand-held metal detectors.<sup>14</sup> Dual-chamber pacemakers are programmed to be more sensitive to electrical stimuli than single-chamber pacemakers, and therefore have the highest incidence of EMI. Dual-chamber pacers are also more likely to revert to asynchronous, fixed-rate pacing from EMI exposure. Pacemaker-dependent persons (those with an intrinsic heart rate of less than 30 bpm) are most likely to experience signs and symptoms attributable to EMI, or from the reversion to asynchronous, fixed-rate pacing. Electronic-artifact surveillance systems (the wand-type of surveillance often used at airports) affect pacemakers more than ICDs, due to the stronger protective-device shielding used in ICDs. In 2000 a study reported that the interaction between pacemakers and electronic-artifact surveillance systems occurred in 20% of dual-chamber pacers and 10% of single-chamber pacers.<sup>15</sup>

On the other hand EMI may cause inappropriate discharge of an ICD. The incidence of inappropriate ICD discharges was estimated as less than 1% per patient per year in a study, published in 2001, of 341 ICD patients who were followed retrospectively over a 3-year period. Interrogation of the ICDs revealed instances where defibrillation (device activation) occurred in the absence of either ventricular tachycardia or ventricular fibrillation. After excluding other sources of interactions, such as muscle contractions, lead fracture, and dislocation of the connector, it was concluded that EMI was the sole source of electrical interference. The ICD erroneously identified the EMI as a life-threatening arrhythmia and delivered a shock.<sup>16</sup> The overall number of EMI occurrences is likely underestimated; non-sustained episodes of EMI may have occurred unbeknownst to the patient or terminated spontaneously before the device(s) responded. In addition to documented EMI effects, unusual environmental interactions with ICDs have occurred, such as during showering, while seated at a slot machine, and while using an electric razor. Several of the ICD episodes clearly involved EMI, while the origin of others is less clear. Older generation ICDs and those implanted in the upper abdomen are more likely to be affected by EMI than the newer generation ICDs. Better identification of 50 to 60 cycle (Hz) interference has improved differentiation of ventricular arrhythmias and rapid patient movement from EMI, which lessens the occurrence of inappropriate ICD discharges. Similarly, industry advances in pacemaker lead technology, such as bipolar sensing and pacer leads dedicated to defibrillation instead of integrated bipolar sensing circuits have also reduced EMI. Since most of the patients are aware of the potential of EMI they often worry about how certain electrical equipment and devices will affect their pacemaker or ICD. All patients need to be reassured that most devices have

features that prevent interference from household appliances, including microwaves and office or shop equipment.<sup>17</sup> It is also safe to pass through metal detectors at airports and electronic anti-theft devices used by department stores. While safe to use, cell phones should not be carried in a chest pocket directly over an implanted device due to the possibility of interference from some high-powered digital cell phones. However, machinery that contains large magnets or strong electromagnetic fields, such as high-voltage electrical transformers, arc welding equipment, and high-current industrial equipment, should be avoided. A brief catalogue of all potential electrical hazards can be very reassuring for most of the patients (Table 1).

Another activity patients need to be counselled about postoperatively is *car driving*. Initially, a patient with an ICD will likely be restricted from driving because of the risk of injury—to himself and others—if he loses consciousness.<sup>18</sup> A relevant law does not exist in our country. In the US restrictions may vary with state law, and patients may be allowed to resume driving if they go for a prolonged period—six months or one year—without receiving a shock, or without fainting when they are shocked. Relevant guidelines have been issued by the American Heart Association<sup>19</sup> and the European Society of Cardiology.<sup>20</sup>

Finally, regardless of which type of device the patient has, the importance of taking all medications as prescribed needs to be emphasized. The nurse counsellor must explain that antiarrhythmics and other drugs work in conjunction with pacemakers and ICDs to help control the heart's rhythm and remind patients that those with pacemakers need to follow-up with their cardiologist once or twice each year, while those with ICDs may need to do so once every three to six months. At

these visits, the physician will check the device's settings, collect information stored in its memory, and adjust its programming if necessary. The patients with advanced heart failure and a biventricular pacemaker should be specifically instructed to continue their follow-up with both a heart failure specialist and an electrophysiologist.

---

**PSYCHOLOGICAL SUPPORT FOR  
PATIENTS WITH AN IMPLANTED  
CARDIAC DEVICE**

---

The majority of patients who are implanted with a device experience a desirable quality-of-life and a high acceptance rate especially when their symptoms improve postoperatively. More specifically, the group of patients with a VVI or DDD pacemaker report an acceptable health related quality of life. Nevertheless, a recent Swedish study showed that the most socially vulnerable groups of the pacemaker population like women, single persons, as well as elderly and retired persons experience worsening of their life status after a pacemaker implantation.<sup>21</sup> On the other hand, 30 to 50% of patients who had an ICD implanted reported some degree of negative effect, such as fear, anxiety, and depression.<sup>22</sup> Additionally, lifestyle changes that affect driving, sexual activity, social interactions, physical appearance and physical activity further complicate the life of the recipient. Younger implanted patients, some as young as 4 years of age, those <50 years of age, and those who experience high rates of shocks have been identified as being at special risk for development of psychological distress and poor health outcomes.<sup>23</sup>

The major psychosocial concerns, no matter what the age of the patient, include device dependency, fear of shock, poor body image, device malfunction, significant lifestyle changes, unpredictability of therapy, and isolation. These concerns may translate into anxiety disorder, depression, shock expectancy, post traumatic stress disorder, panic attacks, and phobias.<sup>24</sup> It appears that anxiety and depression increase with the frequency of shock episodes for the patients who carry an ICD. Anxiety about the ICD firing is closely associated with the occurrence of depression, while avoidance of activities is associated with anxiety.<sup>25</sup> "Worry" about the ICD and a belief that ICD firing can be predicted is associated with anxiety sensitivity. The patient develops a belief that shock can be predicted. Monitoring of signs of impending shock begin to increase. This leads to hypervigilance regarding body sensations that are often provoked by anxiety. This can lead to increased awareness of body sensations, which in turn may lead to the individual associating unrelated chance sensations with shock.<sup>26</sup> When a patient feels anxious or depressed, he also begins to feel less secure and less satisfied with the ICD therapy and report a decrease in quality of life. The resulting anxiety promotes increased avoidance behaviour, fear of increasing autonomic

**TABLE 1. Main Sources of Electromagnetic Interference with Implantable Cardiac Devices**

<b>Electrical hazards to be aware of</b>	<b>Electrical hazards to avoid</b>	<b>Electrical appliances that are okay to be around</b>
Cellular Phones	Working under the hood of a running car	Microwave ovens
Theft detection devices	MRI (magnetic resonance imaging)	Hair dryers
	Electrocautery – in the operating room or in the dentist's office	Electric blankets and heating pads
	Arc welding	Computers
	Therapeutic radiation	Radios, TVs and stereos

arousal, sleep disturbances, sexual dysfunction, increased irritability and difficulty concentrating.

Researchers<sup>27,28</sup> agree that psychological and emotional support for the patient with an implanted device is an important aspect of care that has not been given as much attention as is needed. Providing the implanted patient time to verbalize fear or concerns related to the device, as well as allowing discussion of the meaning of his or her illness, is an important aspect of a psychological plan for these patients. The nursing staff as part of the team taking care of the patient with an implanted device should give information concerning the device implant as soon as the recipient is informed that the device is necessary. The patient should be provided an opportunity to see and hold a device replica in order to see what it looks and feels like. Patients need to be taught what to expect immediately post-operatively, during recovery, long-term effects, and any limitations that will be present post-implant. Patient's questions concerning sexual activity, anxiety and guilt, device failure and potential death must be dealt with openly and honestly. The family of the patient must be included in this education process. Families of the patient experience some of the same fear and anxiety felt by the device recipient. Reports of parents of children with implants becoming overprotective and spouses exhibiting hypervigilant behaviour have been widely reported.<sup>29</sup> Teaching coping skills related to ICD discharge, and increasing knowledge and understanding of the disease process that precipitates the need for the device, provides the patient with a degree of control. Interventions of this type also facilitate self-management. Eads et al.<sup>30</sup> have suggested using seven unique principles to facilitate psychosocial adjustment during routine follow-up visits for patients with an ICD. These seven principles, which can easily be adopted also for the patients who carry a pacemaker or a cardiac resynchronization device, are:

### 1. DEFINE THE PROBLEM

Allow the patient to pinpoint specific concerns. Some specific concerns that would not ordinarily be identified are memory difficulties, difficulty sleeping, overprotective family, and sexual difficulties, as well as depression, fear of shock, and fear of device malfunction. Questioning patients about personal concerns during routine follow-up visits gives an opportunity to attain needed information, express feelings, and simply chat about the device. Patients need a chance to tell their story. Questions such as "What are your concerns about having a pacemaker/ICD?" and "Are you worried about your pacemaker/ICD?" may stimulate discussion between the pacemaker/ICD clinic staff and the patient.

### 2. PROVIDE INFORMATION

This may be one of the most effective methods of increasing a sense of control. Patients who felt better prepared for living with the device after implantation had better medical and

psychosocial outcomes. On the other hand, erroneous beliefs about the device may result in counterproductive behaviour, such as attempts to predict shock or activities that are believed to induce shock. For some patients, this may translate into a debilitating pattern consisting of progressive limitations in activities and escalation of fearful thoughts. Ongoing patient contact, along with medical knowledge and expertise, puts the nursing staff in an exceptional position to provide information to enhance patient perceptions of control over reactions to their medical diagnosis. Typically, targets of education for the patient comprise explanations about the medical condition, device function and action, and discussions about lifestyle change that come about as a result of the implant. For example, fear of triggering the device during sexual activity is a fear in approximately 50% of patients. Addressing this subject directly is important. Sex is a natural part of life, and this type of physical exertion is particularly anxiety-provoking for patients. It is typically related to the erroneous assumption that sexual activity represents an extreme level of exertion. Interventions may normalize feelings about sexual activity. Nurse counselling a patient with an implanted device may provide education regarding safe levels of sexual activity. Discussing the role of regular exercise may lead to increased confidence about engaging in sex. Information concerning other sources of sexual dysfunction, i.e., medications and vascular disease, is also important. Starting the discussion with the question "Do you have any questions for me about the pacemaker/ICD?" may be a good way to engage use of this principle.

### 3. CREATE TEAM SUPPORT

Social support is a significant enhancement to adjusting to cardiac illness. Ensuring trusting and supportive relationships with family and friends on whom the device patient can depend is important for adjusting to the implant. It is important to note that healthcare providers are psychosocial providers and significant sources of support to this patient group. Patients especially value the relationship that is developed with the people who fully understand their needs. Even so, patients may still need an invitation to talk about and express their needs; therefore, open communication is very important. Open this discussion with "We would like you to think of yourself as part of your treatment team."

### 4. NORMALIZE FEARS

Approximately 13–38% of ICD patients experience diagnosable levels of anxiety, and nearly one-third report fear of shock. ICD shock can be extremely uncomfortable, and those patients who receive more than one shock consecutively may be at risk for a high incidence of psychosocial complications. Engaging the ICD patients in discussion that normalizes emotions enables the follow-up staff to help the patients talk about their fears and other reactions relating to the ICD. The follow-up staff can then assure patients that fear is an expected

part of having an ICD implant and is neither a sign of poor outcome nor an abnormal occurrence. When fear is labelled as a safe and inevitable part of treatment, patients become less sensitive to the presence of fear. Accepting fear may enhance the patient's confidence to resume a normal life despite the threat of shock. The statement "Feeling stressed about the device is a normal reaction" may spark this discussion.

#### 5. ENCOURAGE EMOTIONAL RELEASE

Patients who avoid talking about the negative aspects of their device are at increased risk of ongoing emotional distress. Merely affording a patient the opportunity to discuss worrisome issues with an open and empathic listener allows for emotional catharsis. Asking "Can we discuss your feelings about your device?" may lead to relief from the burden of harbouring unexpressed concerns, and may precede resolution of uncertainties connected with the device. As important as this principle is, implementation is time-intensive. The nursing staff might consider allowing brief discussion periods with the patient on a routine basis, which may help in decreasing extreme emotional outburst that take more time with which to deal.<sup>1</sup>

#### 6. A STATEMENT SUCH AS "IT IS POSSIBLE TO RETURN TO YOUR NORMAL ACTIVITIES AFTER YOU RECOVER" WILL INSTILL HOPE

It is very important to assure the implanted patients that the physical discomfort and emotional distress they are experiencing will more than likely diminish with time. Overall, quality of life and psychosocial functioning in the areas of emotional behaviour, alertness, and social interaction temporarily decline six months post implant. Follow-up studies at 12 months have found that all areas of functioning return to baseline.

#### 7. ENCOURAGE PATIENTS TO TAKE ACTION

The follow-up staff can effectively foster self-efficacy behaviours in patients by providing instruction about self-care and by encouraging the belief that patients possess the capacity to successfully care for themselves. It is psychologically enhancing for patients to resume everyday activities after receiving the device. There are times patients may need encouragement to maintain a degree of physical exertion over time, including exercise or sexual activity.

Other approaches for psychosocial intervention of the patient implanted with a cardiac device have also been implemented. One such approach is the initiation of cognitive behavioural therapy<sup>31</sup> while alternative therapies such as progressive muscular relaxation, breathing techniques, deep relaxation, and self hypnosis, taught early and re-enforced through out follow-up, have helped the patient cope with the new stress of an implant.<sup>32</sup> However, regardless of the type of intervention chosen to offer psychosocial and emotional support to the recipients of an implantable cardiac device, the role of the nurses as educators and advocates for this

unique and challenging population is extremely important, and are the continuous link to the multidisciplinary team of professionals that guide the oftentimes forgotten humanistic care of these patient.<sup>33</sup>

---

### CONCLUSIONS

---

With more and more patients receiving pacemakers, ICDs, and combination devices, a need for multidisciplinary approach to meet these population-specific needs becomes obvious. Nurses who have a holistic outlook on patient care can play a key role in this health care team by supporting these patients and their families during as well as after implantation. To accomplish this task nursing intervention must be multi-level. In-hospital and long-term care will ensure an uneventful procedure and a safe discharge as well as early detection of device malfunction and late complications. Education of the patient will prevent any self or environmental interactions which can adversely affect proper device function and will increase his/her adherence to the follow-up treatment. Finally, by providing psychosocial and emotional support the nursing staff can address the immediate concerns of the patient and help him/her cope successfully with his/her new life situation. To be able to meet the requirements of this complex role is essential that nurses taking care of patients with implanted devices receive training and continuing education in this rapidly evolving field.

### REFERENCES

1. American Heart Association: Statistics. Heart disease and stroke Statistics 2004 update (charts).
2. Shaffer R. ICD therapy: the patient's perspective. *AJN* 2002; 102:46-50.
3. Moss AJ, Daubert J, Zareba W. MADIT-II: clinical implications. *Card Electrophysiol Rev* 2002;6:463-465.
4. Manolis AS. Cardiac resynchronization therapy in congestive heart failure: Ready for prime time? *Heart Rhythm* 2004;3:355-363.
5. Bradley D, Bradley E, Baughman K, et al. Cardiac resynchronization and death from progressive heart failure. *JAMA* 2003; 289:730-740.
6. Ector H, Vardas P. On behalf of European Heart Rhythm Association, European Society of Cardiology. Current use of pacemakers, implantable cardioverter defibrillators and resynchronization therapy. *Eur Heart J* 2007; 9(suppl 1):144-149.
7. Corona GG. Pacemakers: keeping the beat today. *RN* 1999; 62:50-54.
8. Corona GG. Update on implantable pacemakers. *RN* 2002; 65:52-55.
9. Woodruff J, Prudente LA. Update on implantable pacemakers. *J Cardiovasc Nurs* 2005; 20:261-268.
10. Buben RS, Ching EA, Neal Kay G. Cardiac defibrillation and resynchronization therapies. *AACN Clinical Issues* 2004;

- 15:340-361.
11. Wilbur SL, Marchlinski FE. Implantable cardioverter-defibrillator follow up. What everyone needs to know. *Cardiol Rev* 1999; 7:176-190.
  12. Wadas T. The implantable hemodynamic monitoring system. *Crit Care Nurse* 2005; 25:14-16.
  13. Angerstein RL, Thronson F, Rasmussen MJ. Enhancing care for cardiac resynchronization therapy patients: device diagnostics and clinical application. *J Cardiovasc Nurs* 2006; 21:397-404.
  14. Goldschlager N, Epstein A, Friedman P, et al. Environmental and drug effects on patients with pacemakers and implantable cardioverter/defibrillators. *Arch Int Med* 2001; 161:649-655.
  15. Mugica J, Henry L, Podeur H. Study of interactions between permanent pacemakers and electronic antitheft surveillance systems. *Pacing & Clin Electrophysiol* 2000; 23:333-337.
  16. Kolb C, Zrenner B, Schnitt C. Incidence of electromagnetic interference in implantable cardioverter defibrillators. *PACE* 2001; 24:465-468.
  17. Schuster P, Phillips S, Dillon D, et al. The psychological and physiological experiences of patients with an implantable cardioverter defibrillator. *Rehab Nurs* 1998; 23:30-37.
  18. Akiyama T, Powell J, Mitchell LB1 et al. Resumption of driving after life threatening ventricular tachyarrhythmia. *N Engl J Med* 2001; 345(6):391-397.
  19. Epstein AE, Baessler CA, Curtis AB, et al. Addendum to "Personal and public safety issues related to arrhythmias that may affect consciousness: Implications for regulation and physician recommendations. A medical/scientific statement from the AHA and the NASPE". Public safety issues in patients with implantable defibrillators. A Scientific statement from the AHA and the HRS. *Heart Rhythm* 2007; 4:386-393.
  20. Jung W, Anderson A, Camm AJ Recommendations for driving of patients with implantable cardioverter defibrillators. *Eur Heart J* 1997; 18:1210-1219
  21. Malm D, Svensson E, Karlsson JE, et al. Health-related quality of life in pacemaker patients: a single and multidimensional self-rated health comparison study. *J Cardiovasc Nurs* 2003; 2: 291-302.
  22. Thomas S, Friedman E, Kelley F. Living with an implantable cardioverterdefibrillator: a review of the current literature related psychological factors. *AACN Clin Is* 2000; 12:156-163.
  23. Sears SF, Conti JB. Quality of life and psychological functioning of ICD patients. *Heart* 2002;87:488-493.
  24. White MM. Psychosocial impact of the implantable cardioverter defibrillator: Nursing implications. *J Cardiovasc Nursing* 2002; 16:53-61.
  25. Hegel MT, Griegel LE, Black C, et al. Anxiety and depression in patients receiving implanted cardioverter defibrillators: A longitudinal investigation. *Int J Psychiatry in Med* 1997; 27:57-69.
  26. Pauli P, Wiedemann G, Dengler W, Köhlkamp V. A priori expectancy bias and its relation to shock experience and anxiety: A naturalistic study in patients with an automatic implantable cardioverter defibrillator. *J Behavior Therapy* 2001; 32:159-171.
  27. Kuijpers PMJC, Honig A, Wellens HJJ. Effect of treatment of panic disorder in patients with frequent ICD discharges: A pilot study. *Gen Hosp Psychiatry* 2002; 24:181-184.
  28. Sears SF Jr, Conti JB, Curtis AB, et al. Affective distress and implantable cardioverter defibrillators: Cases for psychological and behavioral interventions. *PACE* 1999; 22:1831-1834.
  29. May CD, Smith PR, Murdock CJ, Davis MJE. The impact of the implantable cardioverter defibrillator on quality-of-life. *PACE* 1995; 18:1411-1418.
  30. Eads AS, Sears SF Jr, Sotile WM, Conti JB. Supportive communication with implantable cardioverter defibrillator patients: Seven principles to facilitate psychosocial adjustment. *J Cardio-pulm Rehabil* 2000; 20:109-114.
  31. Smith LC, Fogel D, Friedman S. Cognitive-behavior treatment of panic disorder with agoraphobia triggered by AICD implant activity. *Psychosomatics* 1998; 39:475-477.
  32. Fitchet A, Doherty PJ, Bundy C, et al. Comprehensive cardiac rehabilitation programme for implantable cardioverter defibrillator patients: A randomized controlled trial. *Heart* 2005; 89:155-160.
  33. Sossong A. Living with an implantable cardioverter defibrillator. Patient outcomes and nurse's role. *J Cardiovascular Nursing* 2007; 2:99-104.