Ethical and Regulatory/Legal Issues Surrounding Pacemaker Re-use

Kevin J Weatherwax
Michigan Institute for Clinical and Health Research
University of Michigan Health System
My Heart Your Heart
-The Mission-

• Bridge the gap between the demand for pacemakers and their inadequate supply in low and middle income countries

• Create a blueprint for safe and legal pacemaker reuse in low and middle income countries

• Establish a Pacemaker re-use program with the goal of device acquisition, reprocessing/sterilization, and distribution to patients in need
The 1985 North American Society of Pacing and Electrophysiology Policy Conference examined nearly 2000 patients with previously used pacemakers and concluded that reutilization is not a risk factor for device infection.

The meeting determined that “the world experience indicates that the reuse of cardiac pulse generators is medically efficacious and safe if they are properly cleansed, sterilized, and reliably tested for function and battery life.”
Safety of Pacemaker Reuse
A Meta-Analysis With Implications for Underserved Nations

Timir S. Baman, MD; Pascal Meier, MD; Joshua Romero, BA; Lindsey Gakenheimer; James N. Kirkpatrick, MD; Patricia Sovitch, RN; Hakan Oral, MD; Kim A. Eagle, MD

**Background**—A large disparity in medical health care is clearly evident between developed and underserved nations in the field of cardiac electrophysiology, specifically pacemaker implantation. This study aimed to assess the safety of pacemaker reuse.

**Methods and Results**—A computerized search from January 1, 1970, to September 1, 2010, identified 18 studies with outcomes of pacemaker reuse. The primary outcome was pacemaker infection or device erosion as defined by each individual study protocol. Secondary end points were device malfunction defined as a defect in the structural or electric integrity of the pulse generator. Pooled individual patient data (n=2270) from 18 trials were included in the analysis. The proportion of patients in whom an infection developed after pacemaker reuse was 1.97% (1.15% to 3.00%). There was no significant difference in infection rate between pacemaker reuse and new device implantation (odds ratio, 1.31 [0.50 to 3.40], P=0.580). The proportion of patients in whom device malfunction developed after pacemaker reuse was 0.68% (0.27% to 1.28%). Compared with new device implantation, there was an increased risk for malfunction in the reuse group (odds ratio, 5.80 [1.93 to 17.47], P=0.002). This difference was mainly driven by abnormalities in set screws, which possibly occurred during device extraction, as well as nonspecific device “technical errors.”

**Conclusions**—This study suggests that pacemaker reuse has an overall low rate of infection and device malfunction and may be a safe and efficacious means of treating patients in underserved nations with symptomatic bradyarrhythmias and no other method of obtaining a device. However, the results also denote a higher rate of device malfunction as compared with new device implantation. Patients with highly symptomatic conduction disease may benefit from pacemaker reuse; however, they should be closely monitored for device malfunction, especially during implantation. *(Circ Arrhythm Electrophysiol. 2011;4:00-00.)*

**Key Words:** health care disparity ■ pacemaker ■ meta-analysis
Table. Characteristics of 18 Trials Included in Meta-Analysis

<table>
<thead>
<tr>
<th>Study</th>
<th>Country</th>
<th>Year of Study Completion</th>
<th>No. of Pacemakers Reused</th>
<th>Complications Related to Device Reuse</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Infection</td>
</tr>
<tr>
<td>Balachander[20]</td>
<td>India</td>
<td>1988</td>
<td>140</td>
<td>6 y</td>
</tr>
<tr>
<td>Pescariu et al[7]</td>
<td>Romania</td>
<td>2001</td>
<td>365</td>
<td>35±21 mo</td>
</tr>
<tr>
<td>Linde et al[6]</td>
<td>Sweden</td>
<td>1996</td>
<td>100</td>
<td>32±11 mo</td>
</tr>
<tr>
<td>Panja et al[30]</td>
<td>India</td>
<td>1992</td>
<td>120</td>
<td>7.5±5.6 y</td>
</tr>
<tr>
<td>Kruse[26]</td>
<td>Sweden</td>
<td>1985</td>
<td>487</td>
<td>1</td>
</tr>
<tr>
<td>Kovacs et al[31]</td>
<td>Hungary</td>
<td>1980</td>
<td>28</td>
<td>...</td>
</tr>
<tr>
<td>Cooperman et al[32]</td>
<td>Israel</td>
<td>1984</td>
<td>78</td>
<td>...</td>
</tr>
<tr>
<td>Mond et al[33]</td>
<td>Australia</td>
<td>1978</td>
<td>83</td>
<td>1</td>
</tr>
<tr>
<td>Amikam et al[34]</td>
<td>Israel</td>
<td>1982</td>
<td>132</td>
<td>5 y</td>
</tr>
<tr>
<td>Havia et al[35]</td>
<td>Sweden/Finland</td>
<td>1974</td>
<td>50</td>
<td>22 mo</td>
</tr>
<tr>
<td>Costa et al[27]</td>
<td>Brazil</td>
<td>1982</td>
<td>22</td>
<td>16 mo</td>
</tr>
<tr>
<td>Rosengarten et al[8]</td>
<td>Canada</td>
<td>1987</td>
<td>18</td>
<td>29 mo</td>
</tr>
<tr>
<td>Sedney et al[28]</td>
<td>Holland</td>
<td>1983</td>
<td>214</td>
<td>31.5 mo</td>
</tr>
<tr>
<td>Aren et al[36]</td>
<td>Sweden</td>
<td>1979</td>
<td>19</td>
<td>26 mo</td>
</tr>
<tr>
<td>Ferugilo et al[37]</td>
<td>Italy</td>
<td>1978</td>
<td>87</td>
<td>14 mo</td>
</tr>
<tr>
<td>Namboodiri et al[38]</td>
<td>India</td>
<td>2001</td>
<td>5</td>
<td>19.2 mo</td>
</tr>
<tr>
<td>Baman et al[21]</td>
<td>Philippines</td>
<td>2008</td>
<td>12</td>
<td>4 mo</td>
</tr>
</tbody>
</table>

Total: 2270, 35±25 mo

*Denotes mean±SD duration of follow-up.

Baman et al Circ-EP 2011
Performance of re-used pacemakers and implantable cardioverter defibrillators compared with new devices at Groote Schuur Hospital in Cape Town, South Africa

Zimasa V Jama, Ashley Chin, Motasim Badri, Bongani M Mayosi

Abstract
Objectives Little is known about the performance of re-used pacemakers and implantable cardioverter defibrillators (ICDs) in Africa. We sought to compare the risk of infection and the rate of malfunction of re-used pacemakers and ICDs.

Results Data for 126 devices implanted in 126 patients between 2003 and 2013 were analysed, of which 102 (81%) were pacemakers (51 re-used and 51 new) and 24 (19%) were ICDs (12 re-used and 12 new). There was no device infection, malfunction, early battery depletion or device removal in either the re-used or new pacemaker groups over the median follow up of 15.1 months (interquartile range [IQR], 1.3-36.24 months) for the re-used pacemakers, and 55.8 months (IQR, 20.2-77.8 months) for the new pacemakers in the ICD group, no device infection occurred over a median follow up of 27.6 months (IQR, 17.9-78.9 months) for the re-used ICDs and 65.7 months (IQR, 37.6-53.7 months) for the new ICDs. One device delivered inappropriate shocks, which resolved without intervention and with no harm to the patient. This re-used ICD subsequently needed generator replacement 14 months later. In both the pacemaker and ICD groups, there were no procedure-related infections documented for the respective follow-up periods.

Conclusion No significant differences were found in performance between re-used and new pacemakers and ICDs with regard to infection rates, device malfunction, battery life and device removal for complications. Pacemaker and ICD re-use is feasible and safe and is a viable option for patients, in limited access of deserving patients in poor countries to these life-saving interventions.

Methods This was a retrospective case-comparison study of performance of re-used versus new pacemaker and ICDs at Groote Schuur Hospital, Cape Town, South Africa. We included consecutive devices that were implanted between 1st January 2003 and 1st January 2013. As shown in Fig 1, there were 1 721 devices implanted during that time, of which 1 587 (92.2%) were pacemakers and 134 (7.8%) were ICDs. Of the 1 587 pacemakers, 1 257 (79.2%) were new implants and 330 (20.8%) were generator replacements. Of the 134 ICDs, 114 (85.1%) were new implants and 20 (14.9%) were generator replacements.

There were 54 (3.4%) re-used pacemakers and 12 (9%) re-used ICDs implanted during this period, with a total number of 68
FDA Major Milestones

- **September 2012**: FDA Pre-Submission meeting 1
- **December 2013**: FDA Pre-Submission meeting 2
- **June 2015**: Export Permit Application Submitted to FDA
Export Permit via Section 801(e)(2) of the US Food, Drug and Cosmetic Act (FD&C)

- A complete description of the device intended for export;
- A statement indicating that the requestor conducted a search of the Medical Literature Analysis and Retrieval System database and a summary of the search results, as well as a summary of safety data to demonstrate that export of the device will not endanger the public health and safety, or documentation of exemption from this requirement, and
- A letter from the appropriate foreign liaison (person with authority to sign a letter of acceptance for the foreign government) which must be either in English or accompanied by a certified English translation, stating that:
  - The device is not in conflict with the laws of the country to which it is intended for export;
  - The foreign government has full knowledge of the status of the device in the U.S.; and
  - Import is permitted or not objected to.
FDA Approval of Export Permit for Pacemaker re-use

- Ghana
- Sierra Leone
- Philippines
- Nicaragua
- Pakistan
Packaging/Labeling
Closing Thoughts...

- The French philosopher Voltaire wrote that “the best is the enemy of the good,” a saying often invoked in the context of resource-limited health care.

- In our case, an over-emphasis on offering the best therapy—a new pacemaker—may impede the substantial benefits that can be gained from an otherwise effective treatment, particularly when the current alternative for the target population is no treatment at all.
Closing Thoughts...

- Prior publications support the safety of pacemaker re-use
- Establishing a validated pacemaker re-use program will transform a currently wasted resource into an opportunity for a new life
- A prospective, randomized clinical trial needs to be conducted
Thank-you for your attention!

myheartyourheart@umich.edu

lavan@pace4life.org