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Cardiac Device Infections

Contemporary Approach to Diagnosis and Management



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Disclosures

Research support: TyRx & Medtronic. Administered according to a sponsored research agreement (SRA) between Mayo Clinic and TyRx & Medtronic that prospectively defined the scope of the research effort and corresponding budget

Honoraria: Medtronic

Consultant: Spectranetics



Sohail & Raza
Expert Rev Anti Infect Therapy
2010

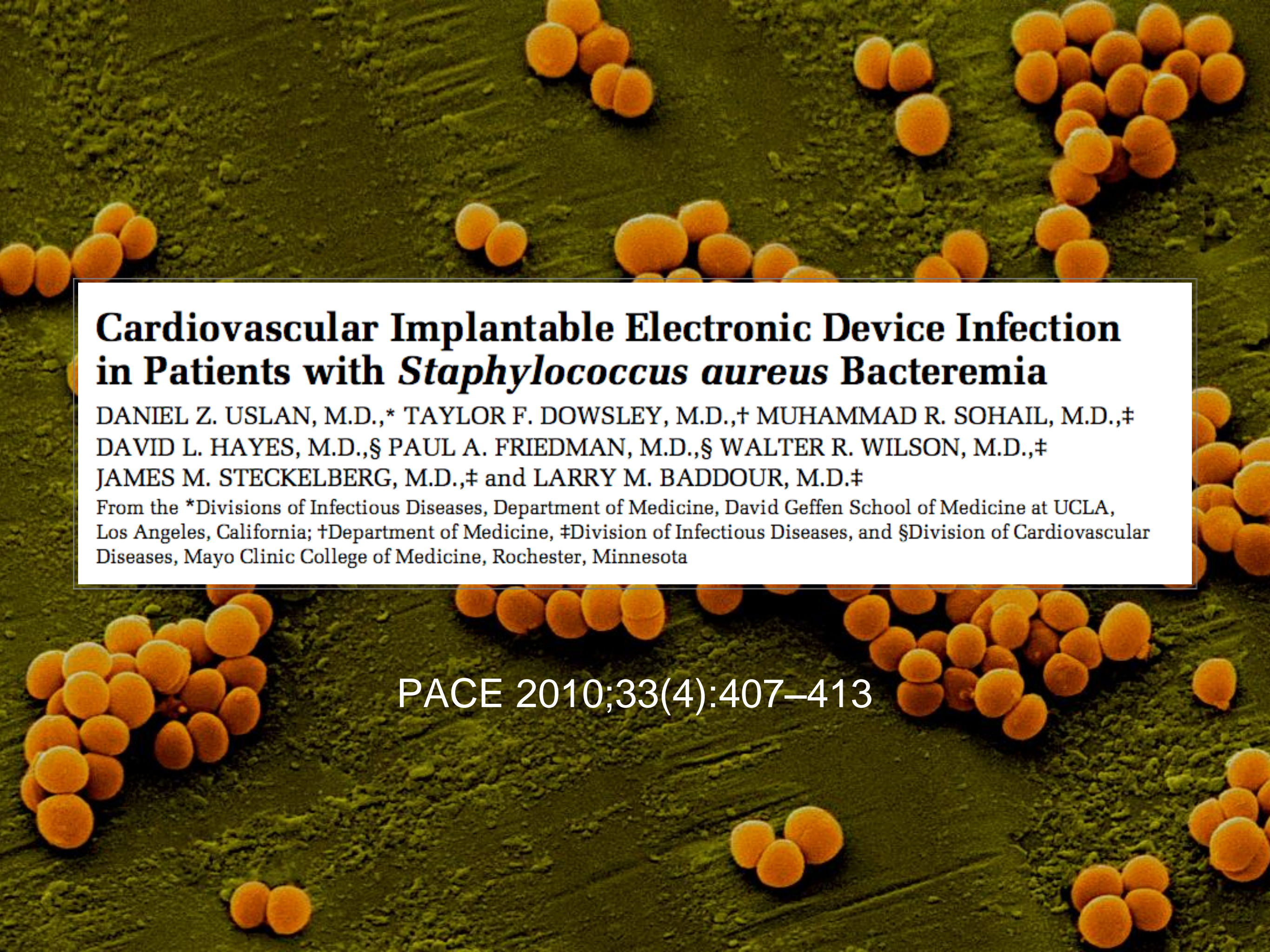
Dababneh & Sohail.
Cleveland Clinic J Med.
Vol. 78 (8) Aug 2011



Case

65 year male with h/o DM, CAD, CKD and pacemaker (implanted 3 years ago) is admitted with:

- ◆ Fever, chills and rigors
- ◆ Pacemaker pocket looks normal. Left leg ulcer with purulent drainage.
- ◆ Admission labs reveals leukocytosis and high CRP.
- ◆ CXR is normal
- ◆ Admission blood cultures are reported to grow GPC at 12 hours.



Cardiovascular Implantable Electronic Device Infection in Patients with *Staphylococcus aureus* Bacteremia

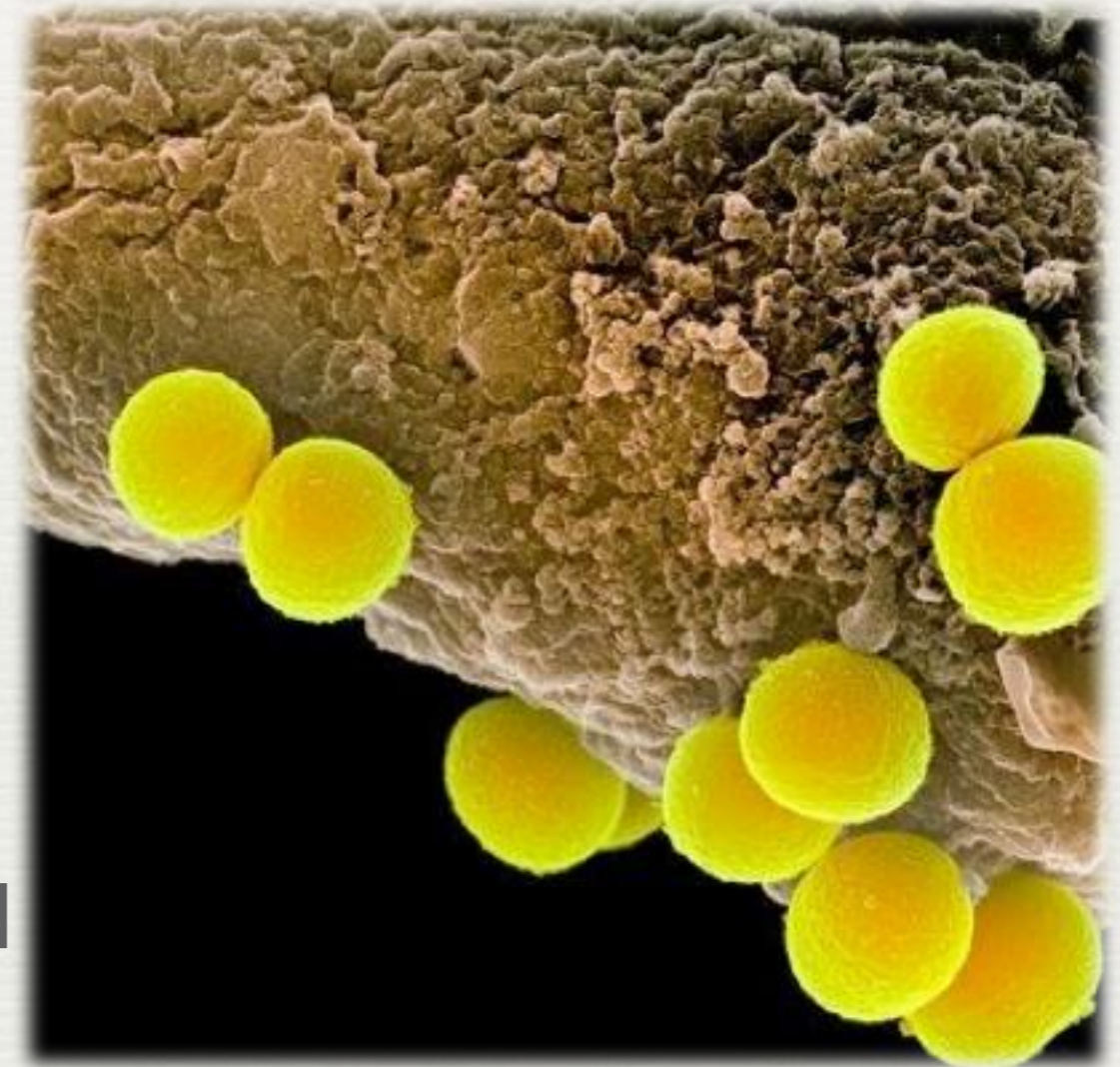
DANIEL Z. USLAN, M.D.,* TAYLOR F. DOWSLEY, M.D.,† MUHAMMAD R. SOHAIL, M.D.,‡
DAVID L. HAYES, M.D.,§ PAUL A. FRIEDMAN, M.D.,§ WALTER R. WILSON, M.D.,‡
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PACE 2010;33(4):407–413

SAB and Device Infection

- ◆ 62 patients with SAB and CIED (2001-2006)
- ◆ 1/3 had CIED-infection
- ◆ Only 30% had generator pocket infection.
- ◆ Presence of PV and ICD increased odds of CIED-infection



Circulation

Arrhythmia and Electrophysiology

JOURNAL OF THE AMERICAN HEART ASSOCIATION

American Heart
Association 
Learn and Live

Outcomes in Patients With Cardiovascular Implantable Electronic Devices and Bacteremia Caused by Gram-Positive Cocci Other Than Staphylococcus Aureus
Malini Madhavan, Muhammad R. Sohail, Paul A. Friedman, David L. Hayes, James M. Steckelberg, Walter R. Wilson, Larry M. Baddour and for the Mayo Cardiovascular Infections Study Group
Circ Arrhythm Electrophysiol 2010;3;639-645; originally published online September 18, 2010;

- ◆ 1/3 had CIED-infection
- ◆ Pocket was source of BSI in 30% patients
- ◆ Prosthesis burden (# of leads) and device revision were associated with CIED infection

MAJOR ARTICLE

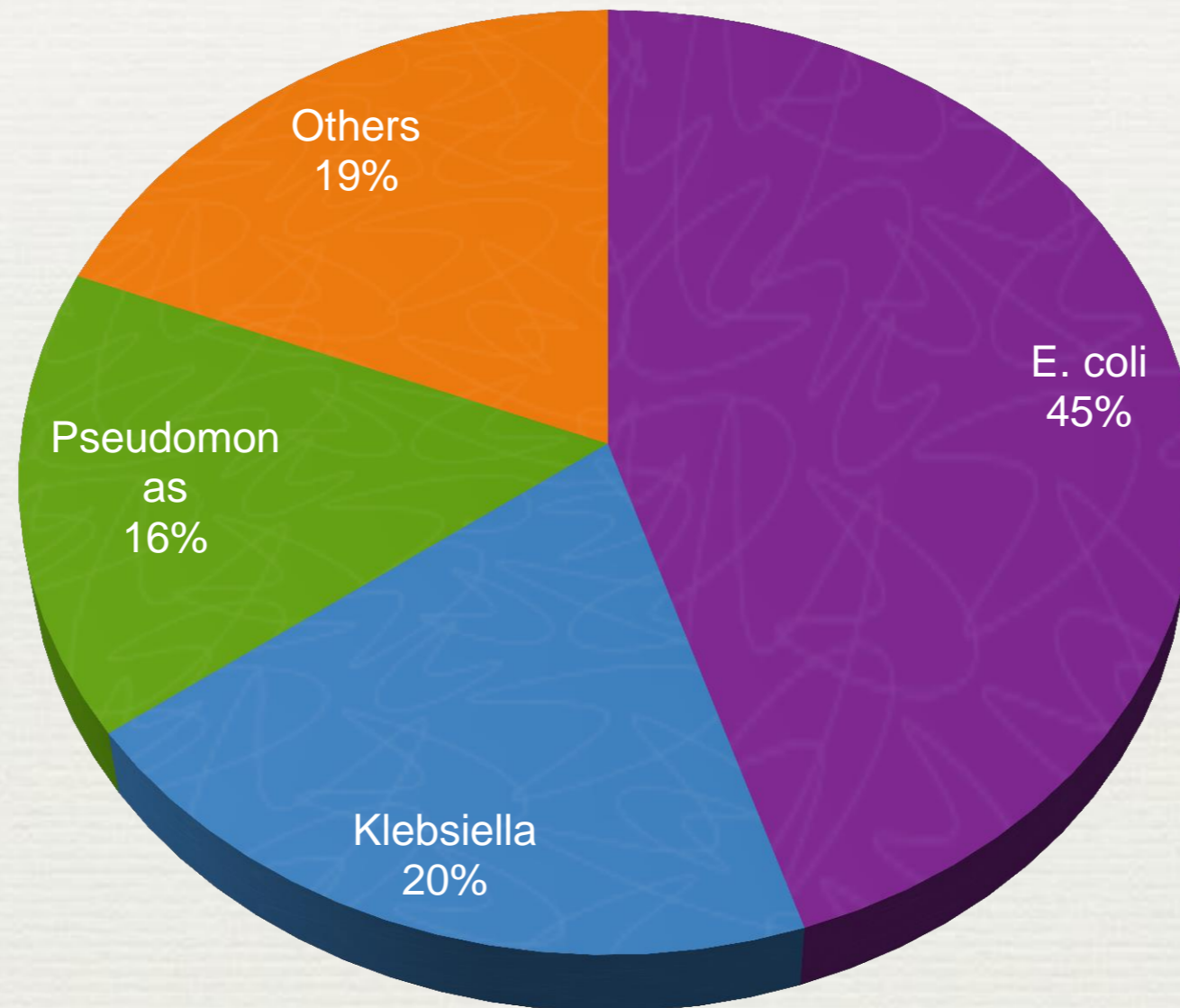
Frequency of Permanent Pacemaker or Implantable Cardioverter-Defibrillator Infection in Patients with Gram-Negative Bacteremia

**Daniel Z. Uslan,¹ Muhammad R. Sohail,³ Paul A. Friedman,² David L. Hayes,² Walter R. Wilson,¹
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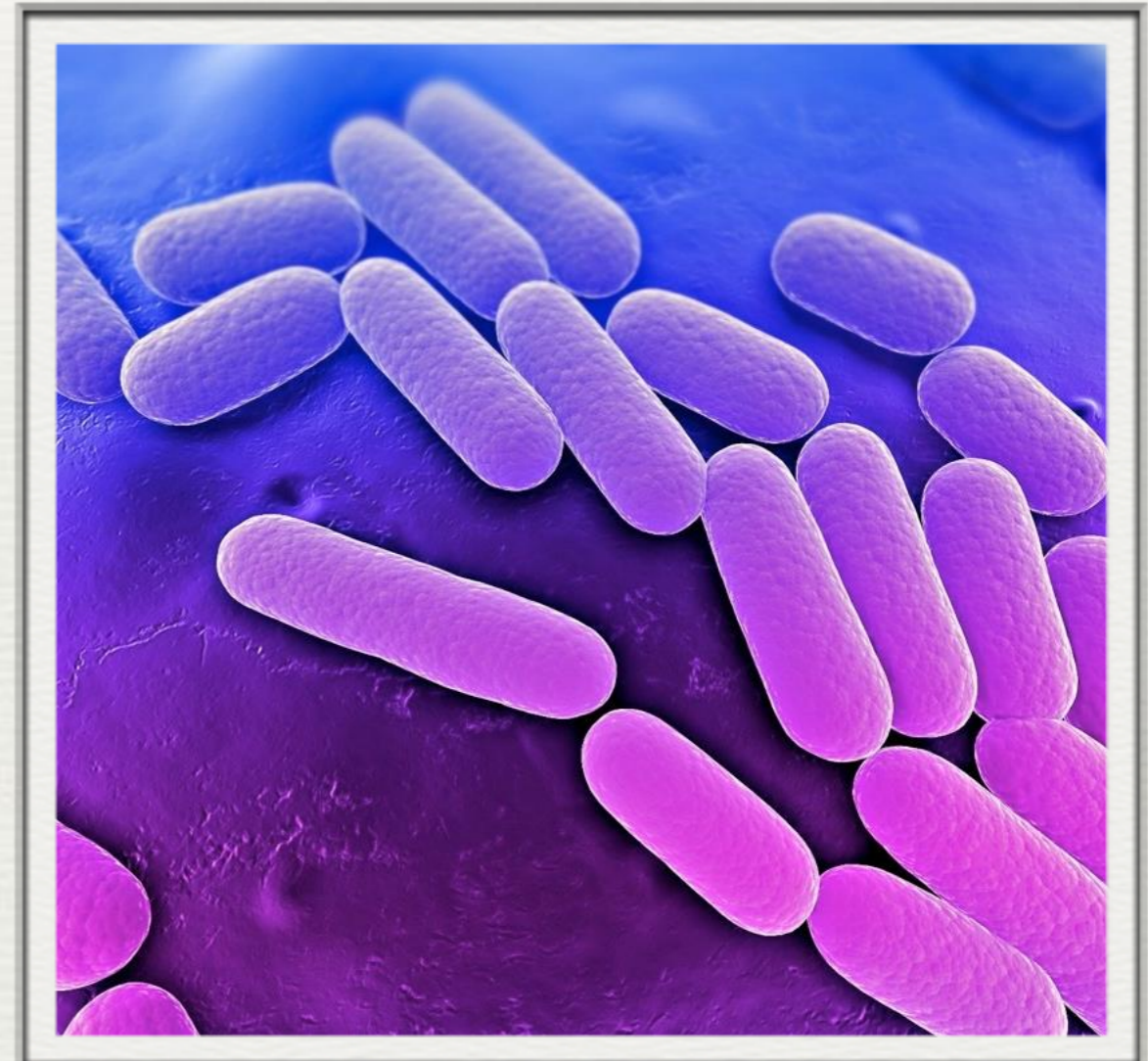
Cin Infect Dis. 2006;43(6):731–736

GNB and CIED-infection



GNB and Device Infection

- ◆ 49 patients from 1998 - 2005
- ◆ 3 (6%) had CIED infection
- ◆ All had generator pocket involvement
- ◆ **NO** cases of hematogenous seeding

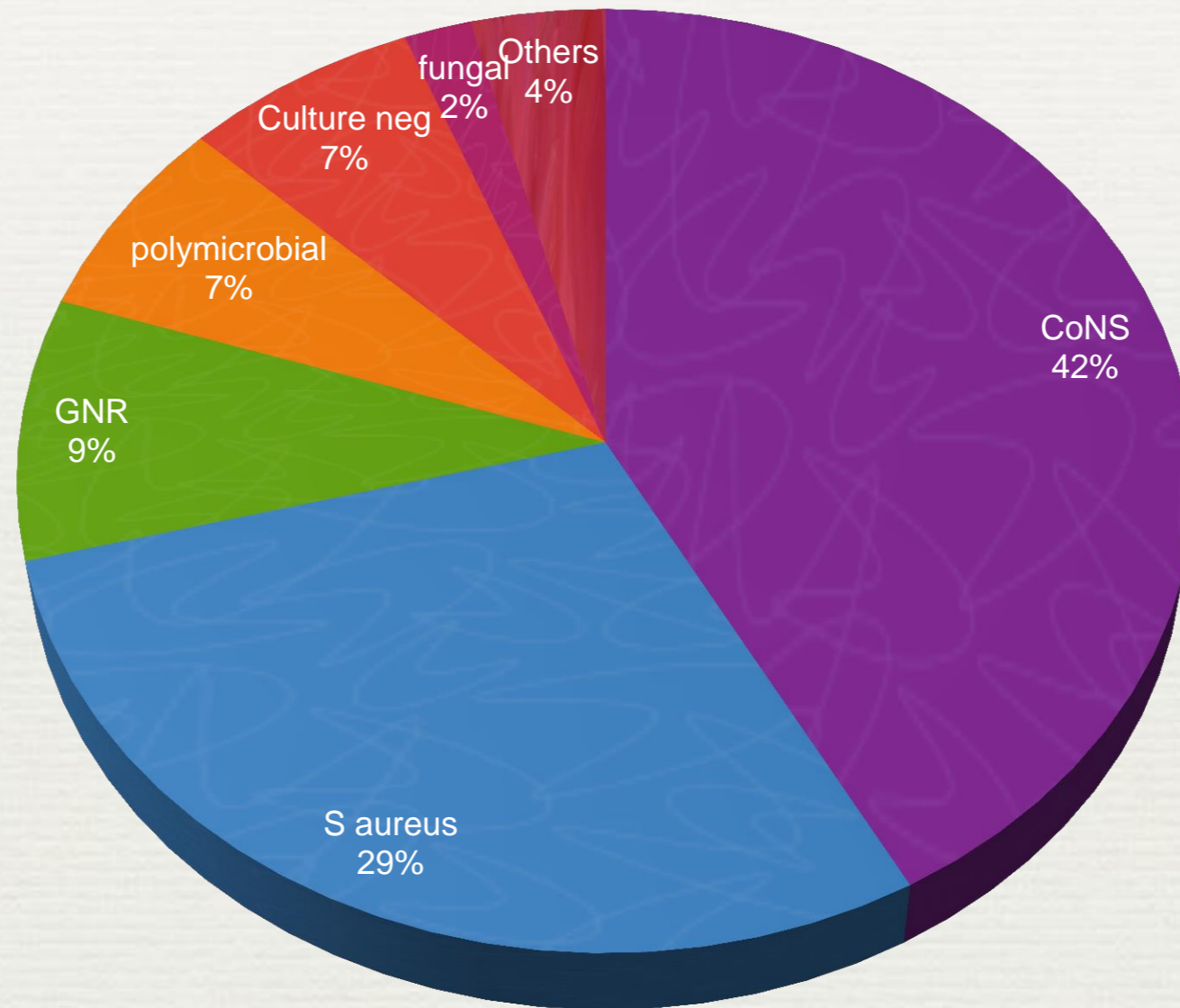


Management and Outcome of Permanent Pacemaker and Implantable Cardioverter-Defibrillator Infections

Muhammad R. Sohail, MD,* Daniel Z. Uslan, MD,* Akbar H. Khan, MD,‡ Paul A. Friedman, MD,†
David L. Hayes, MD,† Walter R. Wilson, MD,* James M. Steckelberg, MD,* Sarah Stoner, MS,§
Larry M. Baddour, MD*

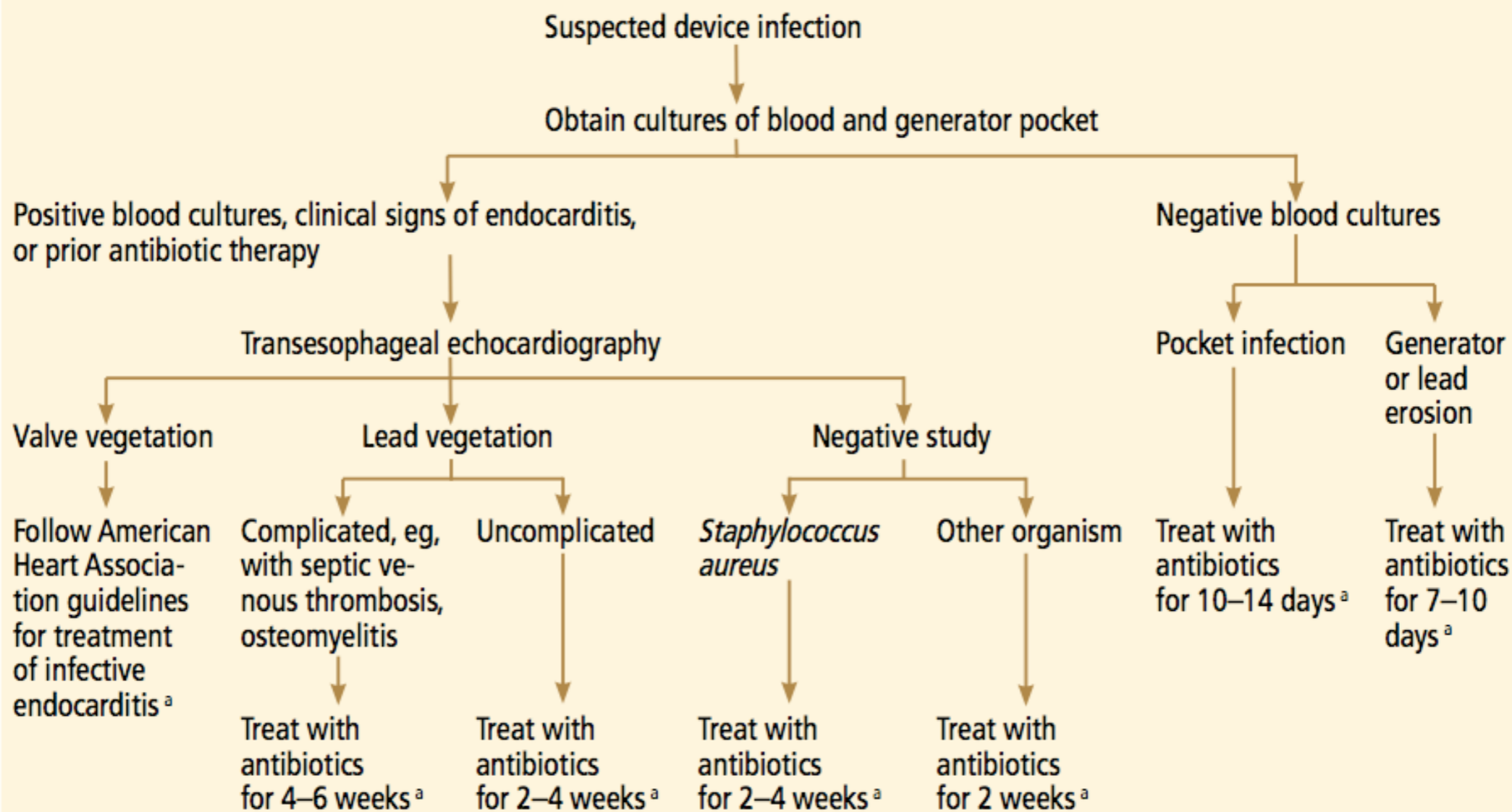
Rochester, Minnesota

Microbiology of CIED Infections



Sohail et al. J Am Coll Cardiol 2007; 49:1851-1859

How to determine the duration of therapy for cardiovascular implantable electronic device infection



^a Duration of antibiotics should be counted from the day of device explantation.

Update on Cardiovascular Implantable Electronic Device Infections and Their Management: A Scientific Statement From the American Heart Association

Larry M. Baddour, Andrew E. Epstein, Christopher C. Erickson, Bradley P. Knight, Matthew E. Levison, Peter B. Lockhart, Frederick A. Masoudi, Eric J. Okum, Walter R. Wilson, Lee B. Beerman, Ann F. Bolger, N.A. Mark Estes, III, Michael Gewitz, Jane W. Newburger, Eleanor B. Schron, Kathryn A. Taubert, on behalf of the American Heart Association Rheumatic Fever, Endocarditis, and Kawasaki Disease Committee of the Council on Cardiovascular Disease in the Young, Council on Cardiovascular Surgery and Anesthesia, Council on Cardiovascular Nursing, Council on Clinical Cardiology and the Interdisciplinary Council on Quality of Care and Outcomes Research

Circulation 2010;121:458-477; originally published online Jan 4, 2010;
DOI: 10.1161/CIRCULATIONAHA.109.192665

Circulation. 2010
121(3):458-477

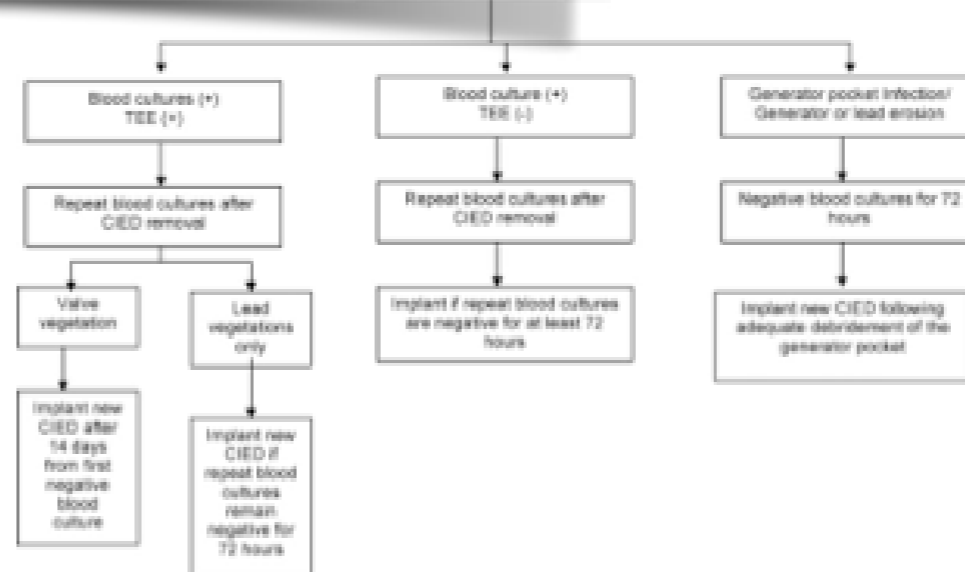
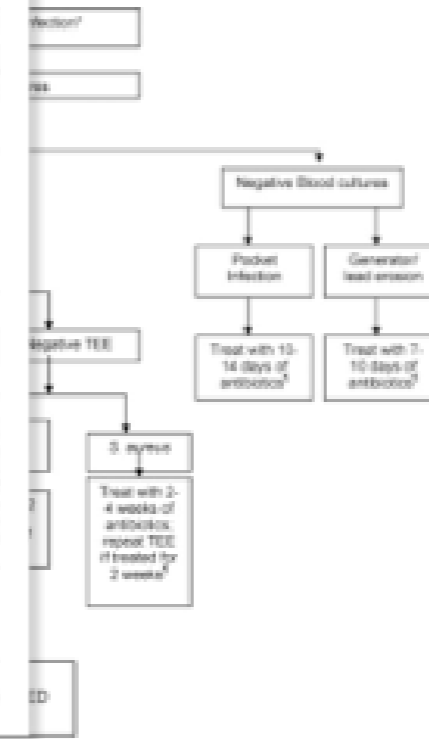
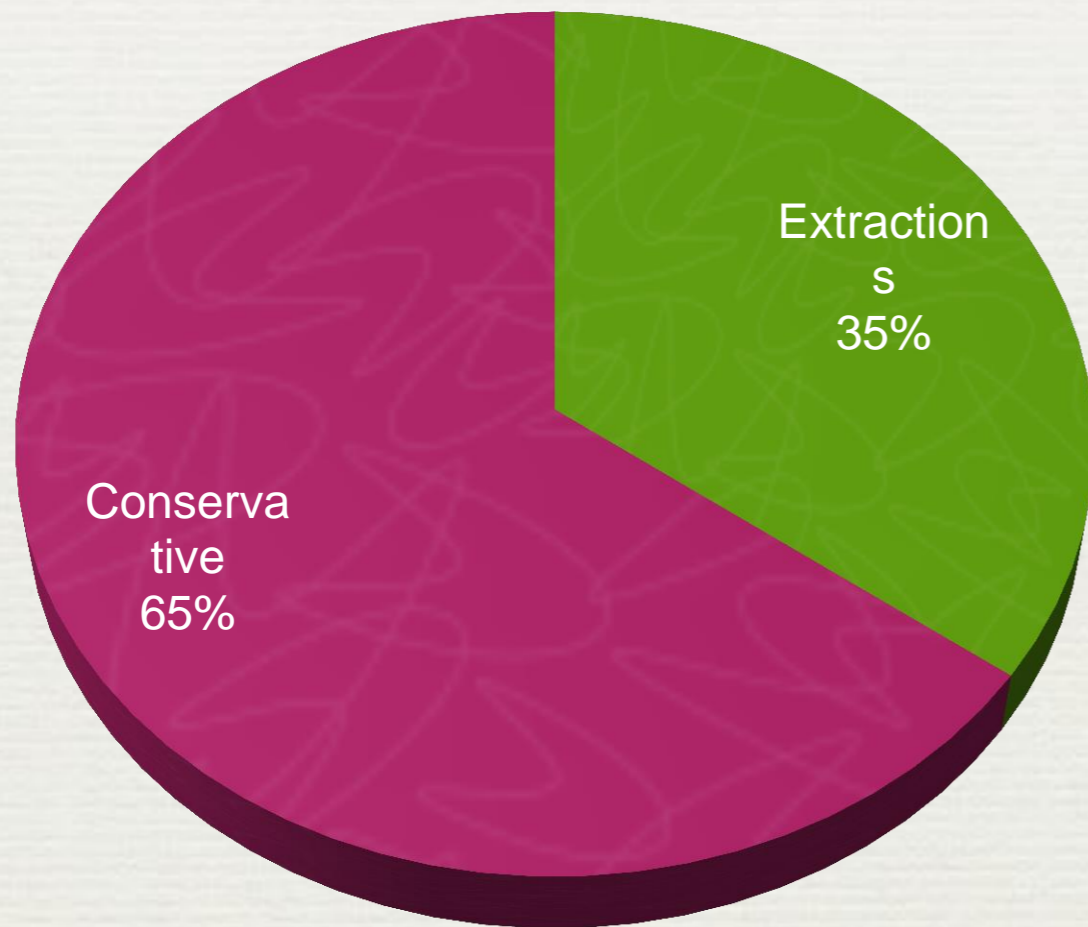


Figure 2. A, Approach to management of adults with CIED infection. AHA indicates American Heart Association. Modified from Sohail et al¹⁸ with permission. *A history, physical examination, chest radiograph, electrocardiogram, and device interrogation are standard baseline procedures before CIED removal. †Duration of antibiotics should be counted from the day of device explantation. Treatment can be extended to 4 or more weeks if there are metastatic septic complications (ie, osteomyelitis, organ or deep abscess, etc) or sustained bloodstream infection despite CIED removal. B, Approach to implantation of a new device in patients after removal of an infected CIED. Modified from Sohail et al¹⁸ with permission.

CIED Infection Management

(National estimates - US)



30,820

Total Infections

10,800

Extractions

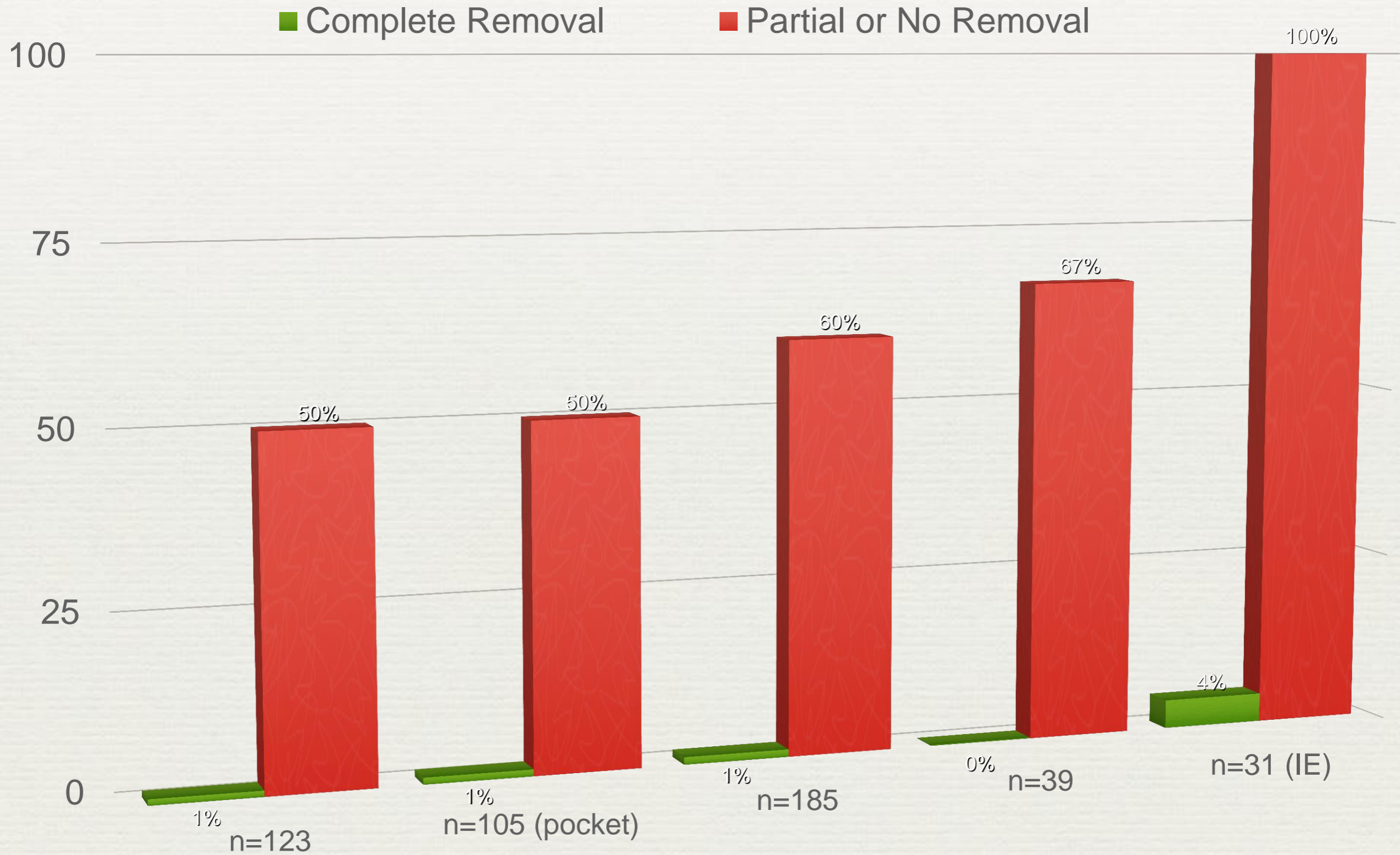
20,020

Conservative Management

65%

Undertreated. Risk of recurrence,
endocarditis or death

Relapse Rates by CIED Infection Treatment



Device Retention = A Fatal Choice

- ◆ Mortality up to 47% if device not removed vs 16% in patients with complete extraction in patients with CIED-SAB
- ◆ Treatment failure (death, recurrence) was more common in cases with device retention (52% vs. 25%)

Chamis, et al. *Circulation*, August 2001 (104): 1029-33

- ◆ Mortality rate in patients with CIED related endocarditis:
 - ◆ Antibiotics alone: 66%
 - ◆ Combined abx + electrode removal: 18%

Cacoub et al. *Am J Cardiol* 1998;82:480–484


Impact of timing of device removal on mortality in patients with cardiovascular implantable electronic device infections

Katherine Y. Le, MD, MPH,* Muhammad R. Sohail, MD,[†] Paul A. Friedman, MD,[‡] Daniel Z. Uslan, MD,[§] Stephen S. Cha, MS,^{||} David L. Hayes, MD, FHRS,[‡] Walter R. Wilson, MD,[†] James M. Steckelberg, MD,[†] Larry M. Baddour, MD,[†] for the Mayo Cardiovascular Infections Study Group

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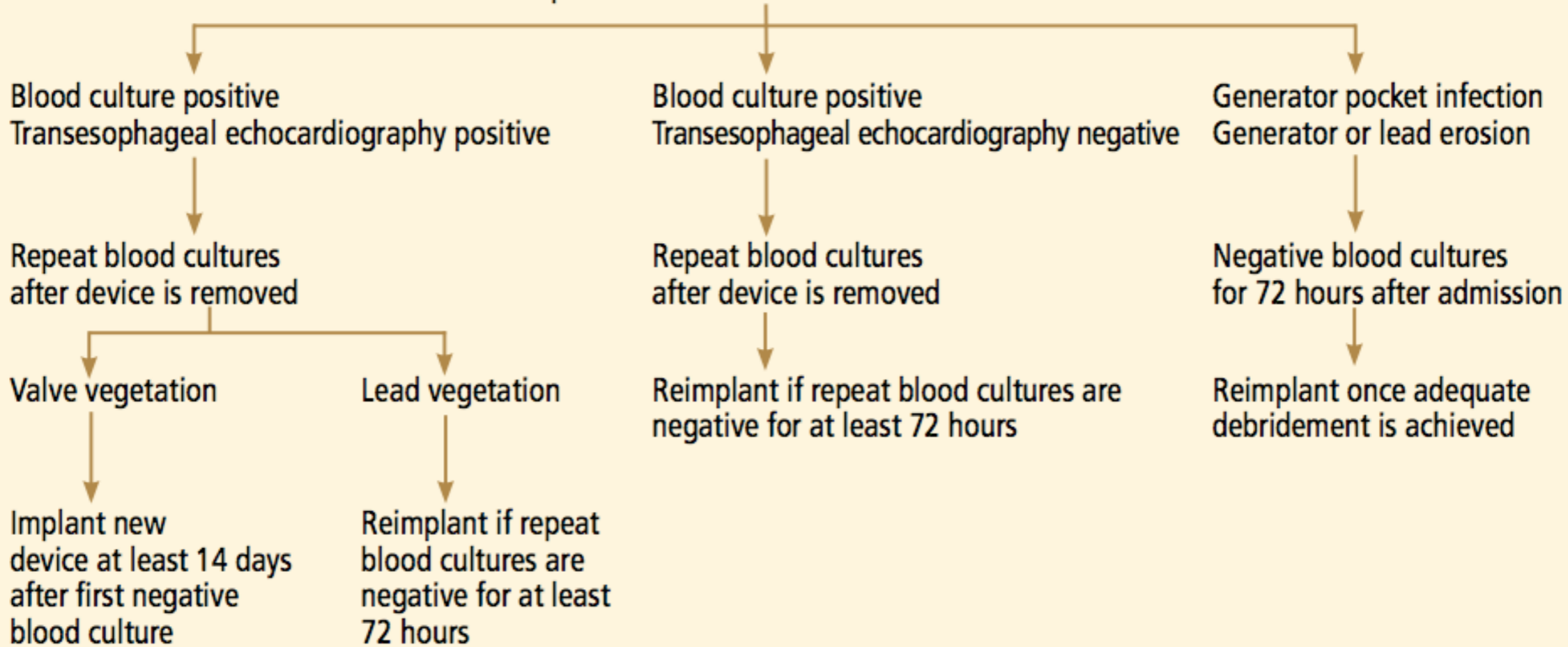
Heart Rhythm 2011; 8:1678 –1685

Timing of Device Removal

- 
- ◆ In multivariate analysis, **conservative management** was associated with a **7-fold increase** in **30-day mortality**
 - ◆ **Immediate device removal**, when compared to delay in device removal, was associated with a **3-fold decrease** in **1-year mortality**

Guidelines for reimplantation of new device in patients with pacemaker or ICD infection

For deciding when to implant a new permanent pacemaker or implantable cardioverter-defibrillator





Europace Advance Access published July 31, 2013



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doi:10.1093/europace/eut220

CLINICAL RESEARCH

Same-day contralateral implantation of a permanent device after lead extraction for isolated pocket infection

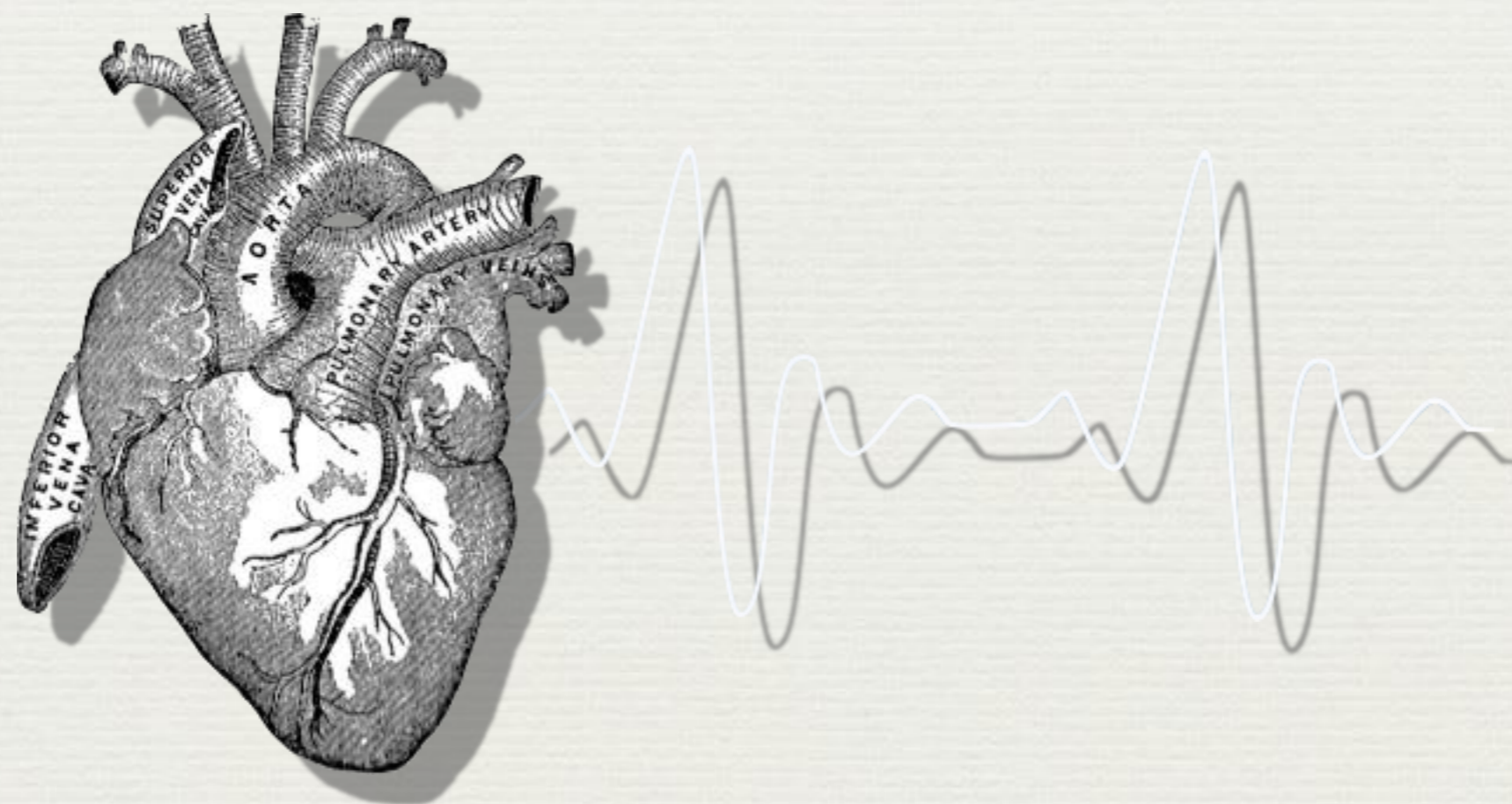
**Stavros E. Mountantonakis^{1*}, Cory M. Tschabrunn², Marc W. Deyell²,
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Received 19 March 2013; accepted after revision 17 June 2013

Retrospective review of patients from 2005 to 2010

Primary Prophylaxis



Centers for Medicare & Medicaid Services

CMS will **STOP** paying hospitals for treating potentially avoidable surgical site infections following Cardiac Implantable Electronic Device (CIED) procedures including pacemaker and defibrillator implants.



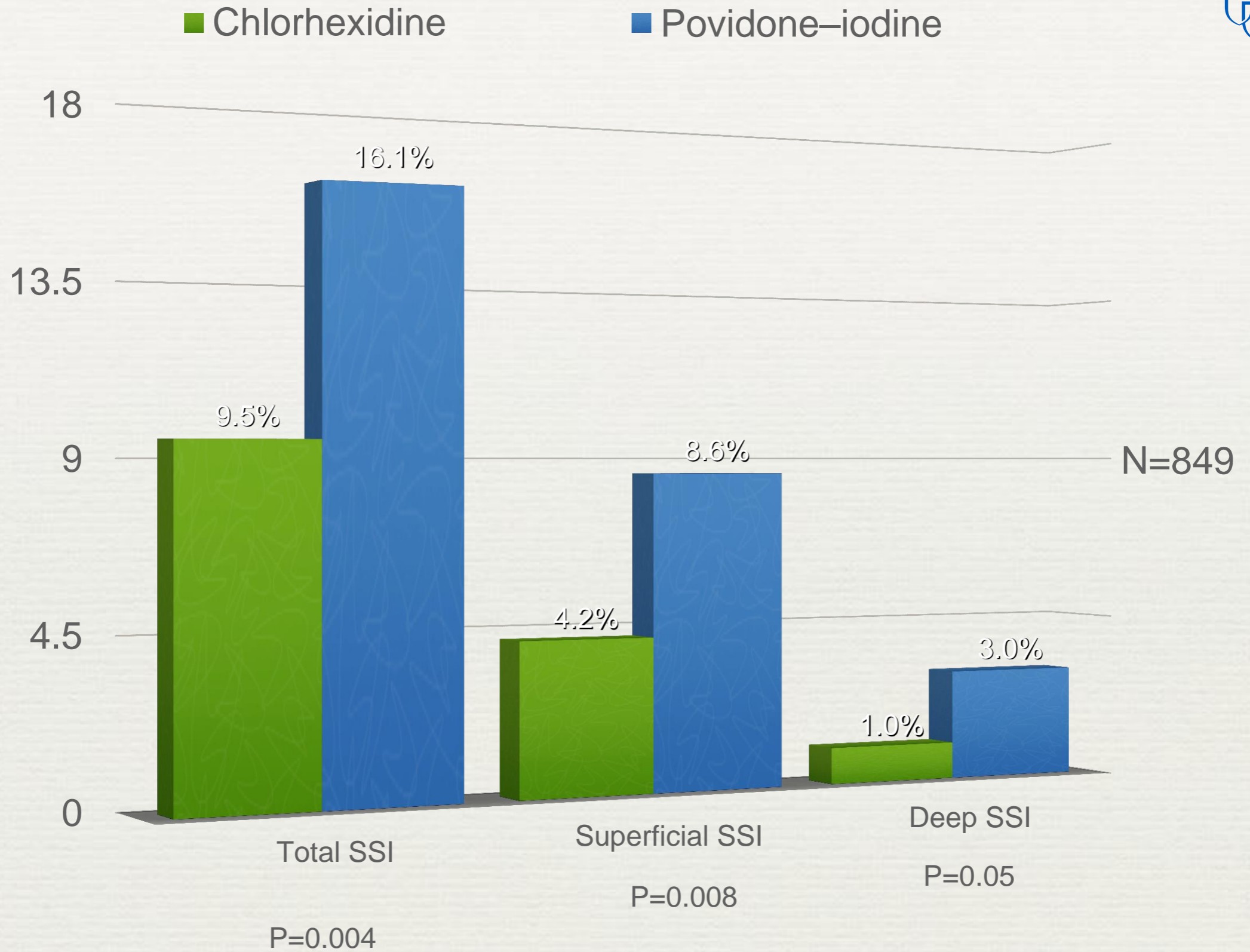
The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Chlorhexidine–Alcohol versus Povidone–Iodine for Surgical-Site Antisepsis

Rabih O. Darouiche, M.D., Matthew J. Wall, Jr., M.D., Kamal M.F. Itani, M.D.,
Mary F. Otterson, M.D., Alexandra L. Webb, M.D., Matthew M. Carrick, M.D.,
Harold J. Miller, M.D., Samir S. Awad, M.D., Cynthia T. Crosby, B.S.,
Michael C. Mosier, Ph.D., Atef AlSharif, M.D., and David H. Berger, M.D.

N Engl J Med 2010; 362:18-26



The Impact of Povidone-Iodine Pocket Irrigation Use on Pacemaker and Defibrillator Infections

DHANUNJAYA LAKKIREDDY,* SRILAXMI VALASAREDDI,† KAY RYSCHON,† KRISHNAMOHAN BASARKODU,† KAREN ROVANG,† SYED M. MOHIUDDIN,† TOM HEE,† ROBERT SCHWEIKERT,* PATRICK TCHOU,* BRUCE WILKOFF,* ANDREA NATALE,* and HUAGUI LI†

From *Cleveland Clinic Foundation, Cleveland, Ohio and †Cardiac Center of Creighton University, Omaha, Nebraska

- ◆ Comparator – saline solution
- ◆ 2,564 consecutive patients from 1994-2002
- ◆ Povidone-iodine was used for pocket irrigation in 53% and saline in 47%
- ◆ **Infection rate was 0.7% in Povidone-iodine group vs. 0.6% in Saline group.**

Circulation

Arrhythmia and Electrophysiology

JOURNAL OF THE AMERICAN HEART ASSOCIATION

American Heart
Association

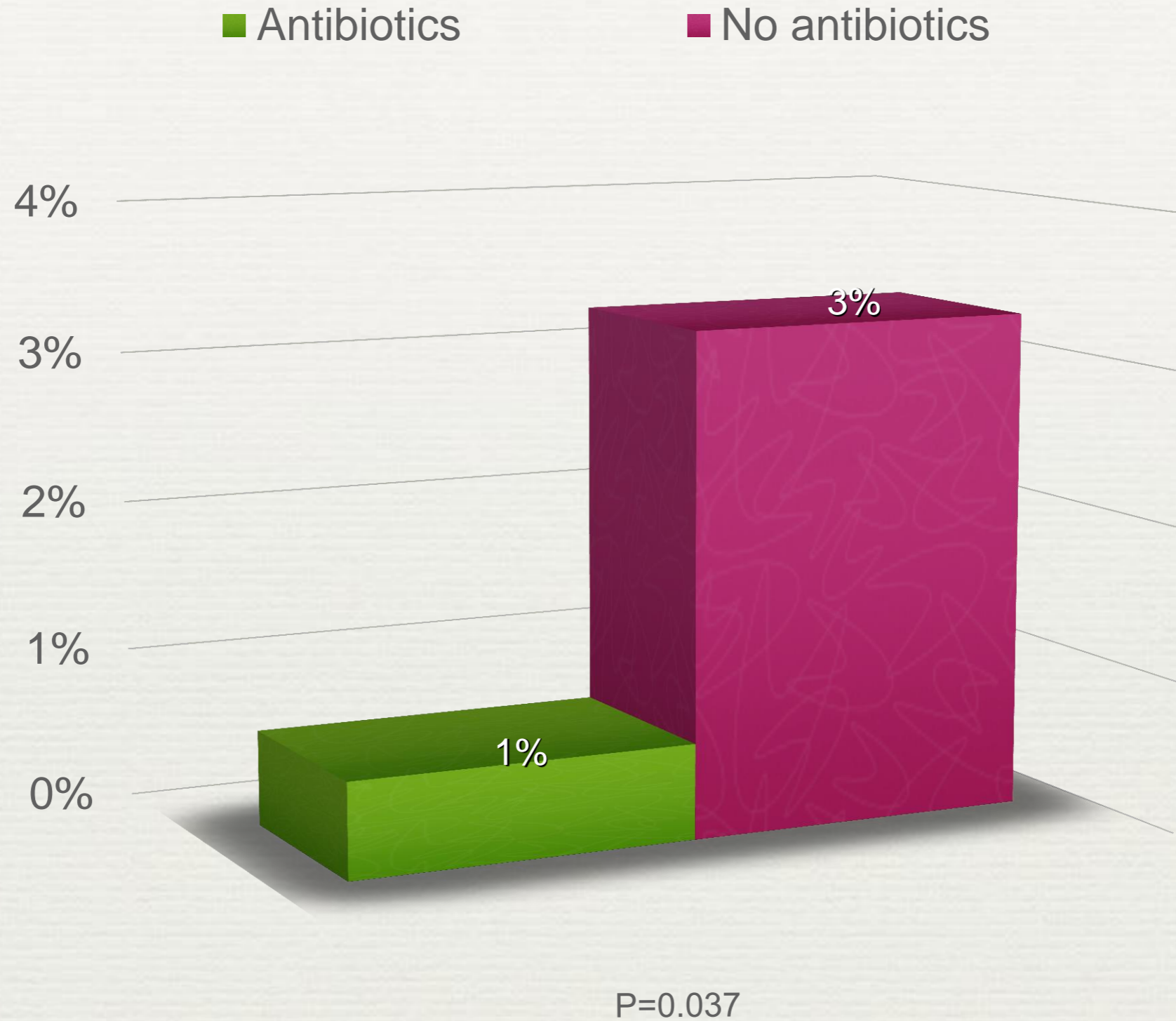


Learn and Live

**Efficacy of Antibiotic Prophylaxis Before the Implantation of Pacemakers and
Cardioverter-Defibrillators: Results of a Large, Prospective, Randomized,
Double-Blinded, Placebo-Controlled Trial**

Julio Cesar de Oliveira, Martino Martinelli, Silvana Angelina D'Orio Nishioka, Tânia
Varejão, David Uipe, Anísio Alexandre Andrade Pedrosa, Roberto Costa and Stephan
B. Danik

Circ Arrhythmia Electrophysiol 2009;2:29-34; originally published online Feb 10,
2009;



De Oliveira et al. Circ Arrhythm Electrophysiol. 2009



Antibiotic Choice - AHA guidelines

- ◆ Antibiotic 1-hour before the procedure
- ◆ A first-generation cephalosporin, such as cefazolin, is recommended.
- ◆ Cephalosporin allergy: Vancomycin
- ◆ Vancomycin allergy: Daptomycin or Linezolid
- ◆ If vancomycin is used, then it should be administered 90 to 120 minutes before the procedure.



Antibiotics after device implantation

Currently, there are no data to support the administration of postoperative antibiotic therapy, and it is **NOT** recommended because of the risk of drug adverse events, selection of drug-resistant organisms, and cost.



Antibiotics are recommended



Antibiotic prophylaxis is recommended if subsequent invasive manipulation of the CIED is required.

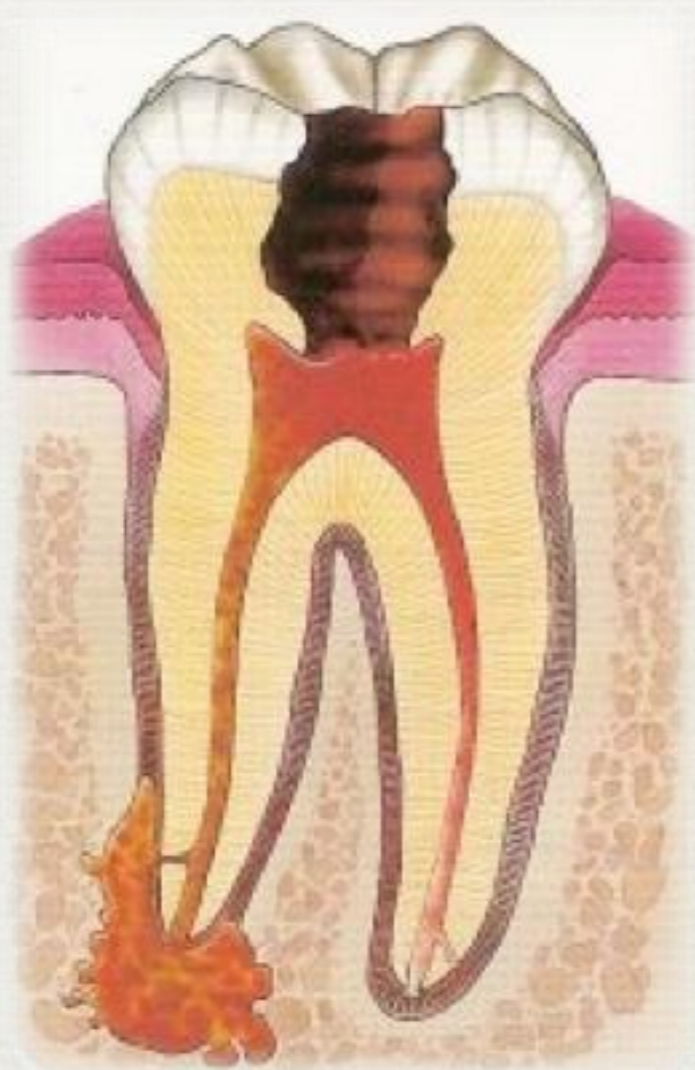


Secondary prophylaxis

A review of the literature from 1950 to 2011 for publications on cardiac electrophysiological device infections reveals more than 200 articles, **none** of which **report hematologic infection** from dental, gastrointestinal, genitourinary, dermatologic, or other procedures.



Antibiotics for dental procedures



- ◆ Antibiotic prophylaxis for dental procedures is of **Little** or **No** value.
- ◆ In the rare event of a device infection due to an oral pathogen, it is most likely to have arisen from a bacteremia from activities of daily life.

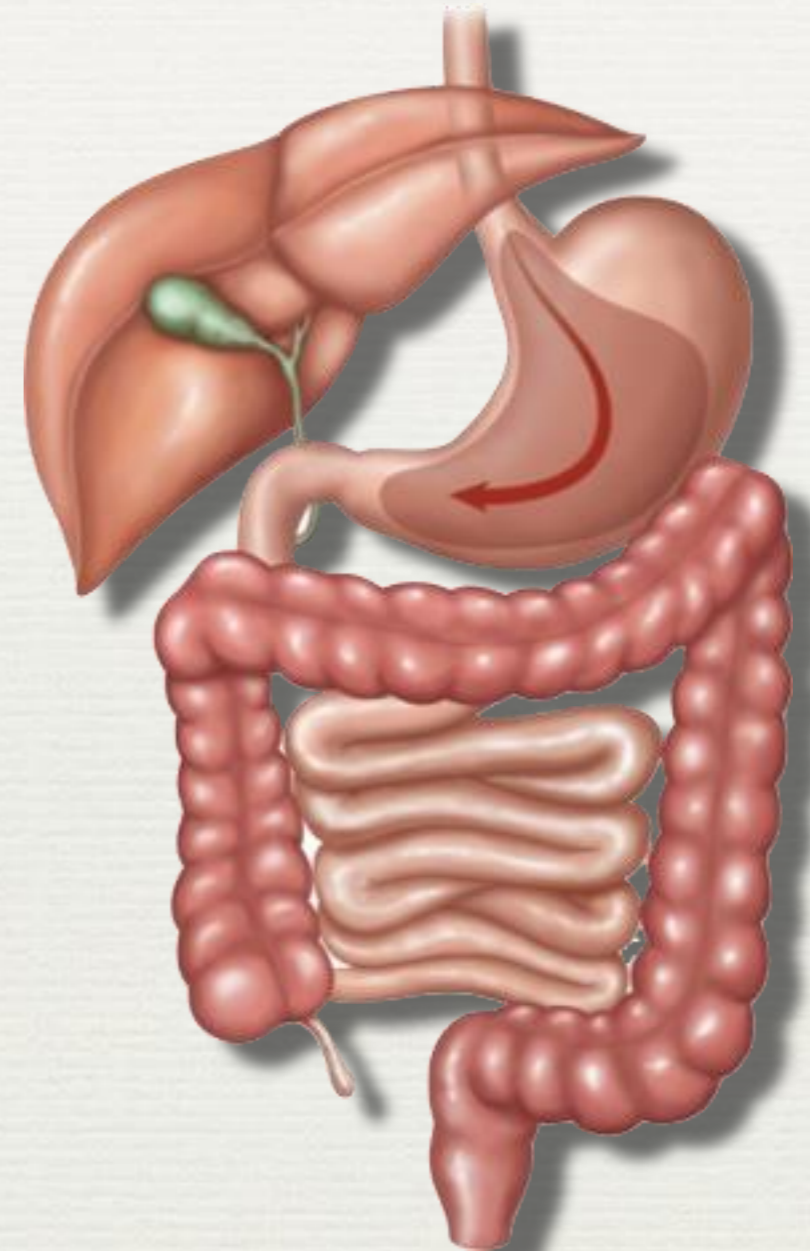




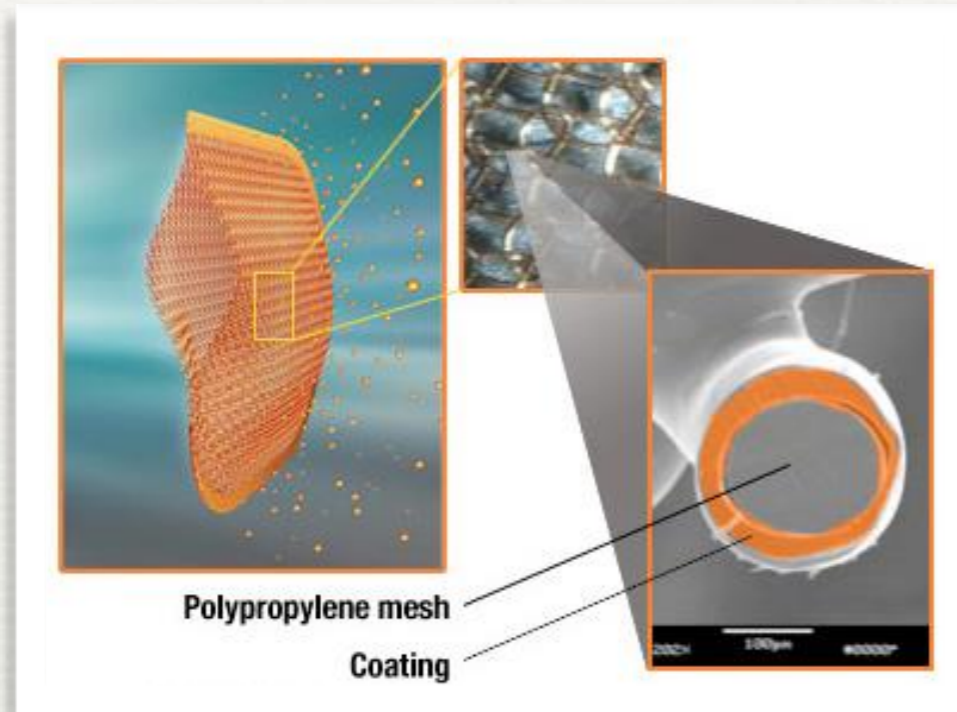
GI & GU Tract Procedures

Use of Prophylactic antibiotics solely to prevent CIED-infection is **NOT** recommended.

(Class III, Level of Recommendation C)



Antibacterial envelope



AIGISRx antibacterial envelope

- ◆ Polymer mesh
- ◆ After implantation, it releases minocycline and rifampin over 7 to 10 day period
- ◆ Stabilize CIEDs

DEVICES

Use of an Antibacterial Envelope is Associated with Reduced Cardiac Implantable Electronic Device Infections in High-Risk Patients

MATTHEW J. KOLEK M.D.¹, WILLIAM F. DRESEN M.D.¹, QUINN S. WELLS M.D.¹, CHRISTOPHER R. ELLIS M.D.^{2,*}

Article first published online: 17 DEC 2012

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Issue

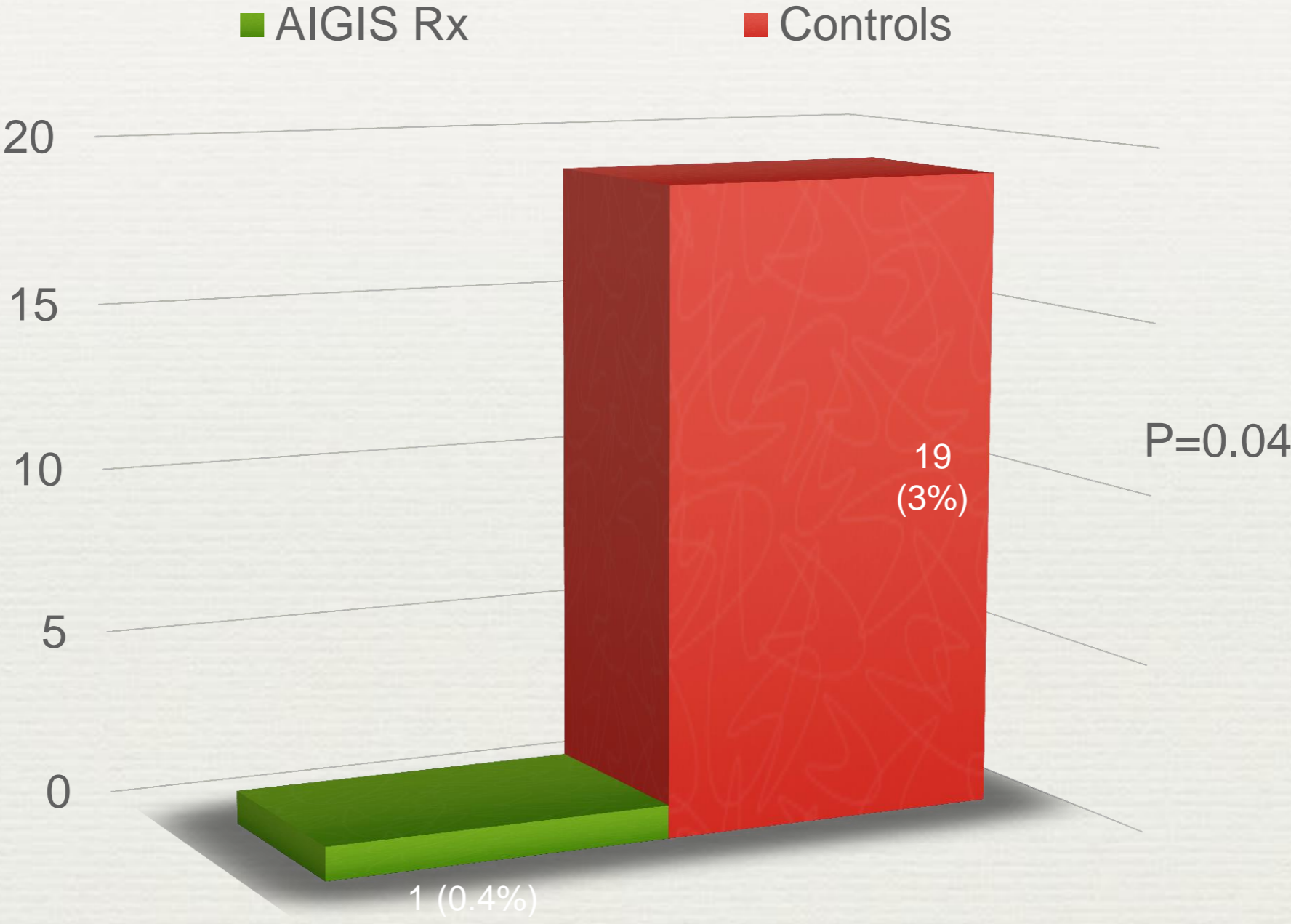


Pacing and Clinical
Electrophysiology

**Volume 36, Issue 3, pages
354–361, March 2013**

PACE. 2013 March, 36(3): 354-61

CIED infections (≥ 90 days follow-up) among AIGIS Rx[®] Cases and controls



 Centurion  Citadel
Interim Analysis



Charles A. Henrikson, MD
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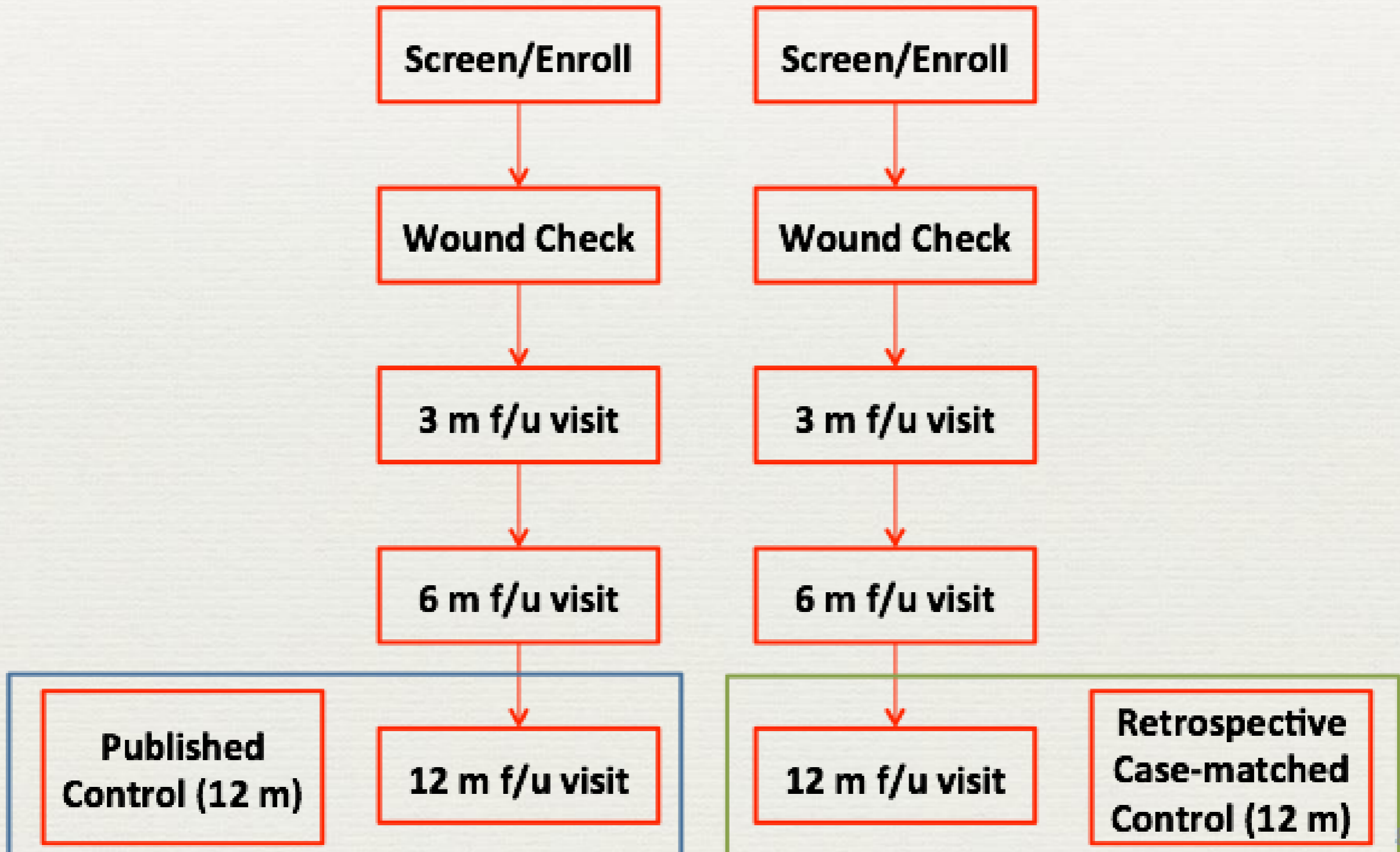
For the CITADEL/CENTURION Investigators


HRS - May 2013 (Denver, CO)

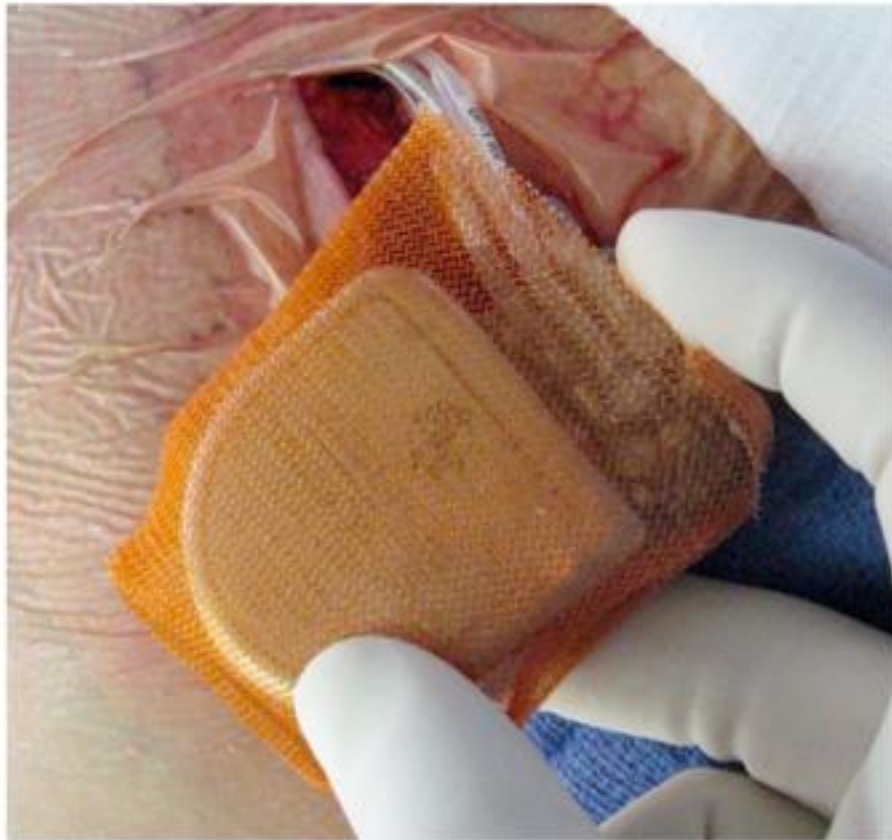
Study Design

CITADEL (ICD)

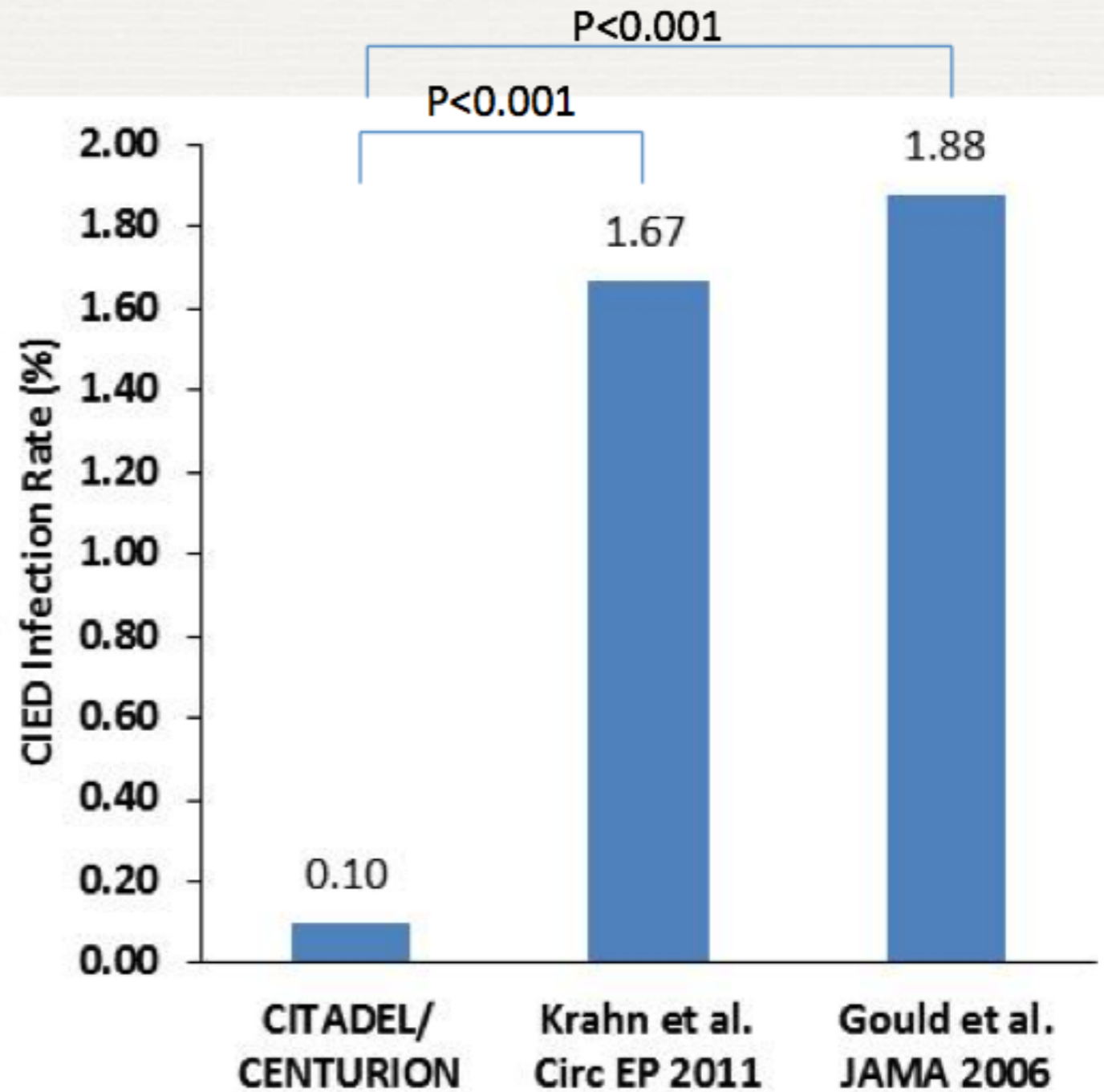
CENTURION (CRT)



Comparison to Published Controls



Comparison by Chi² test



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