Prevention of Sudden Death After MI: Where's the Love?

Craig S. Cameron, MD, FACC, FHRS

Oklahoma Heart Institute

Disclosures: Speaker for Zoll Medical

82 yo man with HTN, DM, dyslipidemia:

- 12/5/19 Inferior STEMI in OKC
  - s/p PCI/DES to culprit RCA
  - LCx occluded proximally
  - Residual diffuse 80-90% mLAD disease
- 12/11/19 NSTEMI → complex PCI of LAD
- 12/12/19 Echo: LVEF 30-35%
- 12/13/19 Ready for hospital discharge
  - On GDMT with ASA/ticagrelor, atorvastatin, carvedilol, and lisinopril

In addition to GDMT, what would you do next?

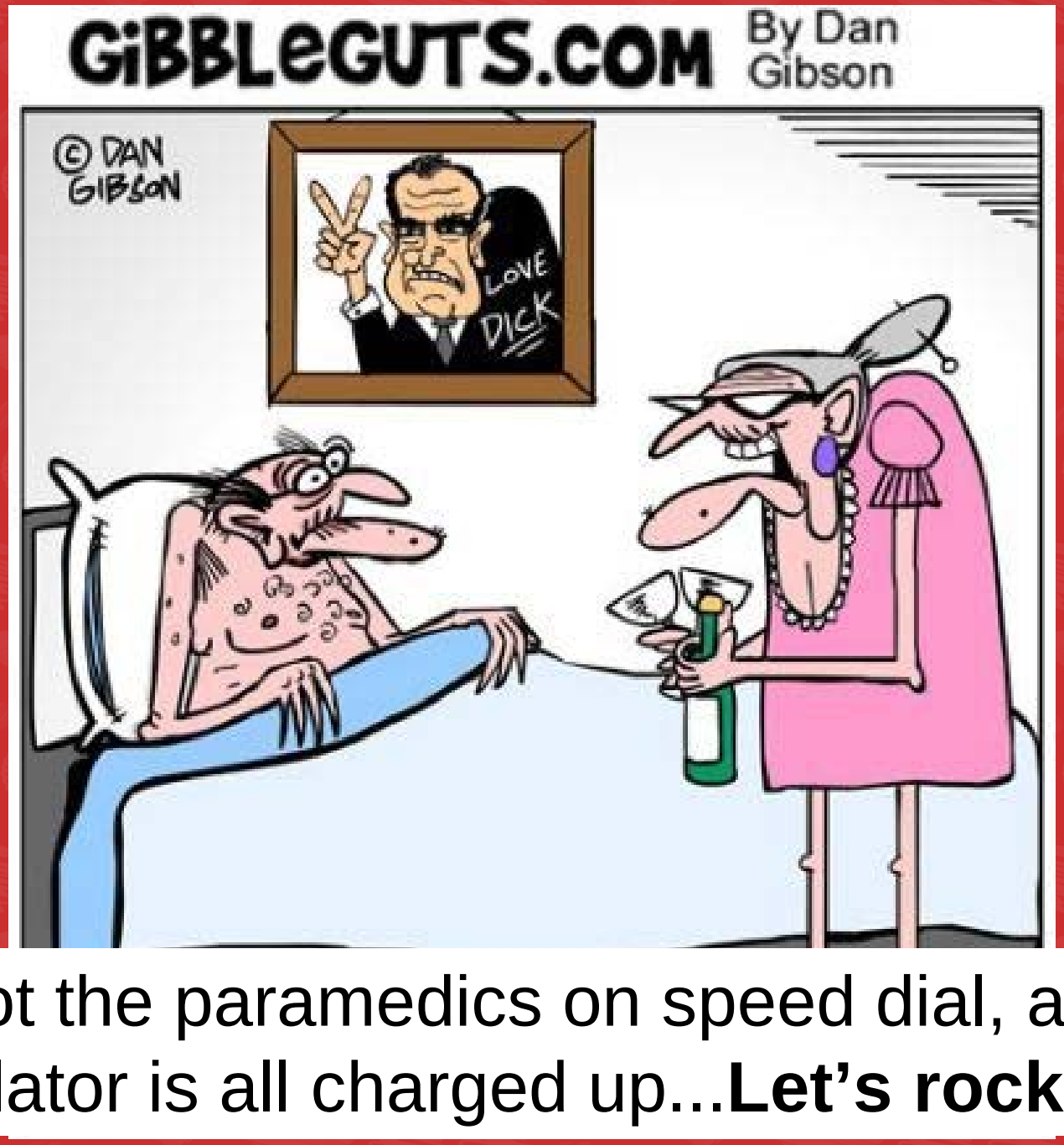
A. Reassess LVEF in 40 days to assess ICD candidacy.

B. Reassess LVEF in 90 days to assess ICD candidacy.

C. Offer a wearable cardioverter-defibrillator (WCD) as a bridge while waiting to re-assess LVEF in 90 days.

D. Implant a transvenous ICD for primary prevention of sudden death.

E. Implant a subcutaneous defibrillator for the primary prevention of sudden cardiac death.



I’ve got the paramedics on speed dial, and the defibrillator is all charged up...**Let’s rock, baby!**

Prevention of Sudden Death After MI:
Happy Anniversary!

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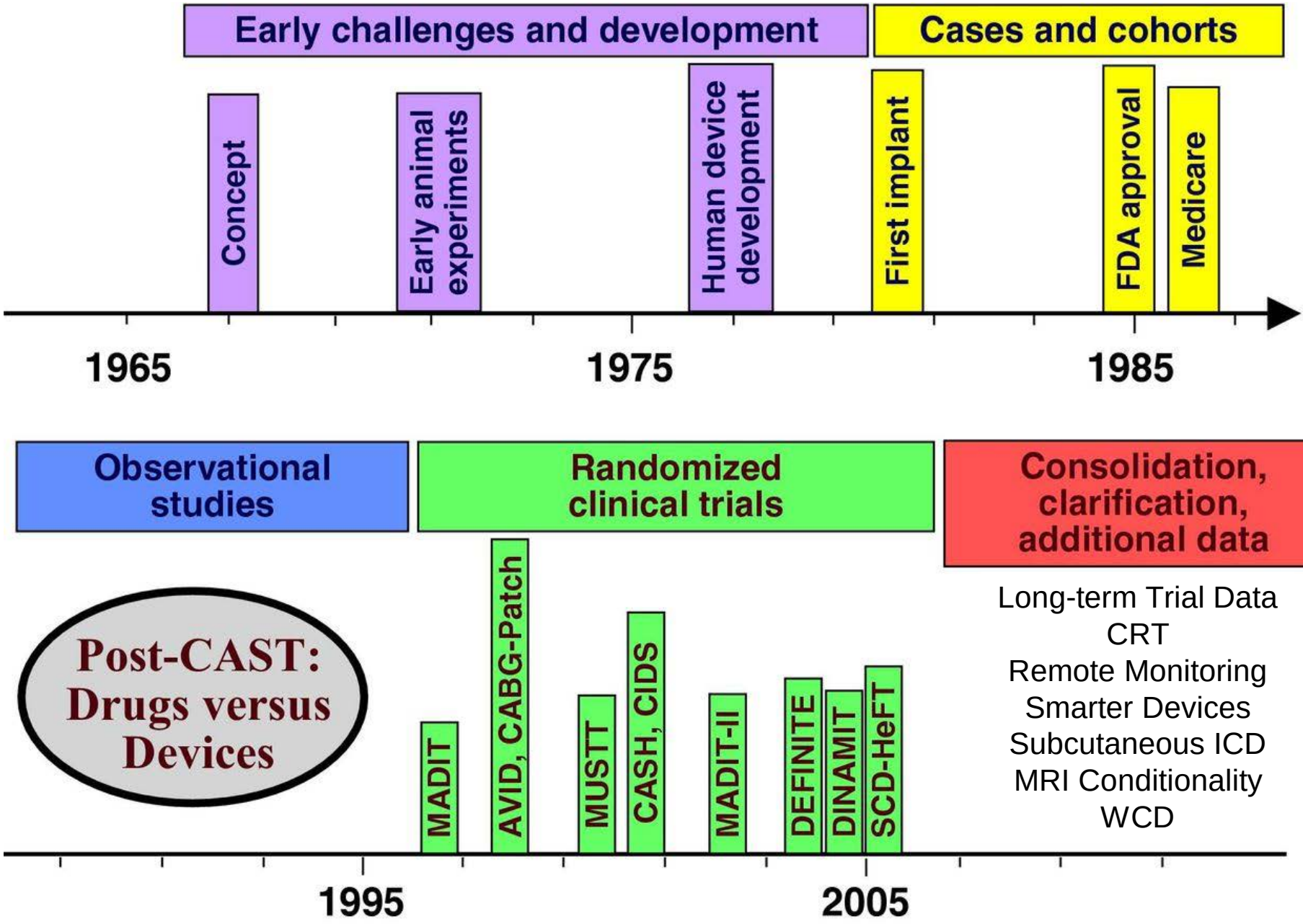
Michel Mirowski and the Implantable Defibrillator

TERMINATION OF MALIGNANT VENTRICULAR ARRHYTHMIAS WITH AN IMPLANTED AUTOMATIC DEFIBRILLATOR IN HUMAN BEINGS

M. Mirowski, M.D., Philip R. Reid, M.D., Morton M. Mower, M.D., Levi Watkins, M.D., Vincent L. Gott, M.D., James F. Schauble, M.D., Alois Langer, Ph.D., M. S. Heilman, M.D., Steve A. Kolenik, M.S., Robert E. Fischell, M.S., and Myron L. Weisfeldt, M.D.

N Engl J Med. 1980 Aug 7;303(6):322-4



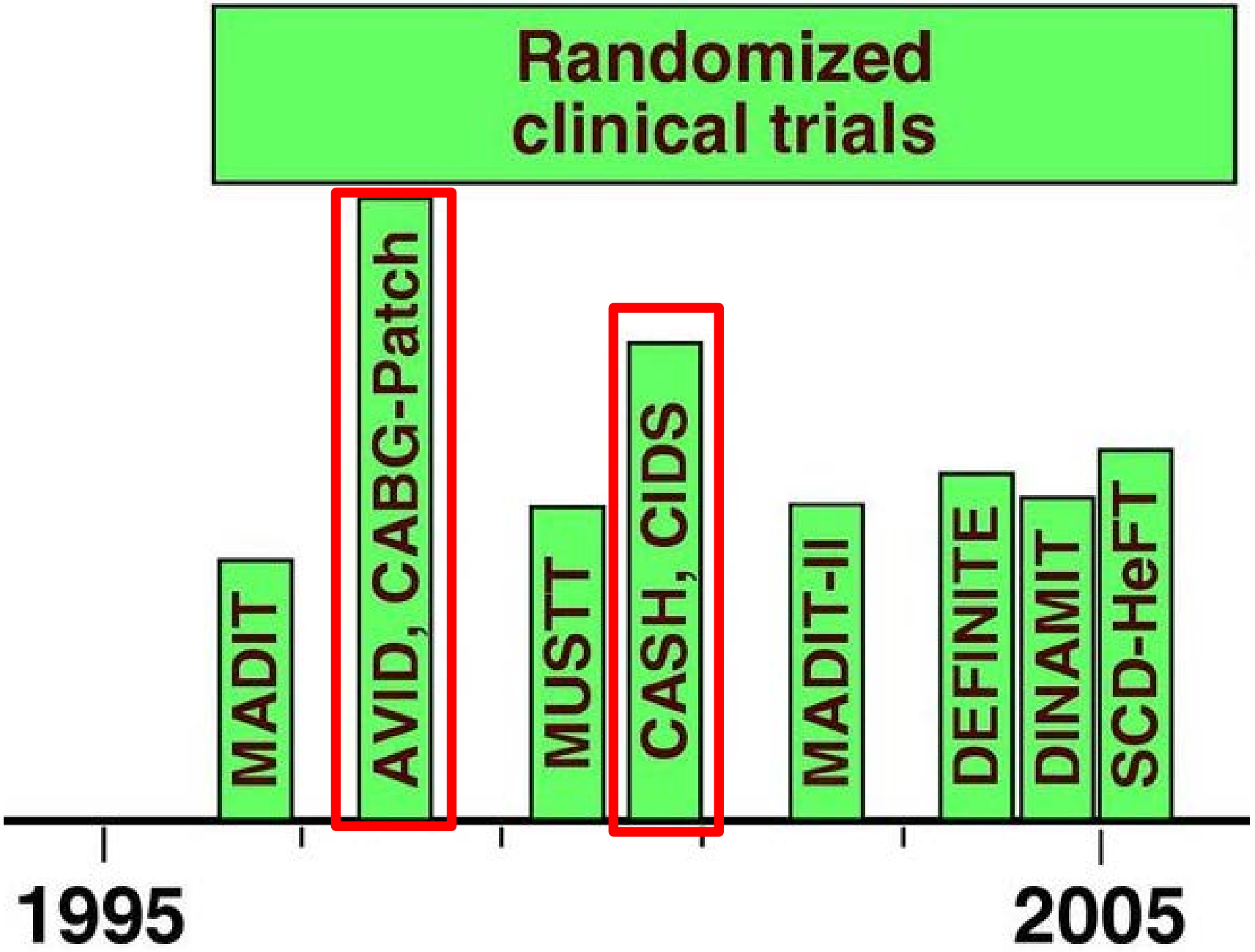
JACC 2009; 54:747–63

Primary vs. Secondary Prevention ICD Implantation

- **Primary prevention** – ICD placement with the intention of preventing sudden cardiac death in a patient who has not had sustained VT or sudden cardiac arrest but who is at an increased risk for these events.

- **Secondary prevention** – ICD placement in a patient with prior sudden cardiac arrest, sustained VT, or syncope caused by ventricular arrhythmias.

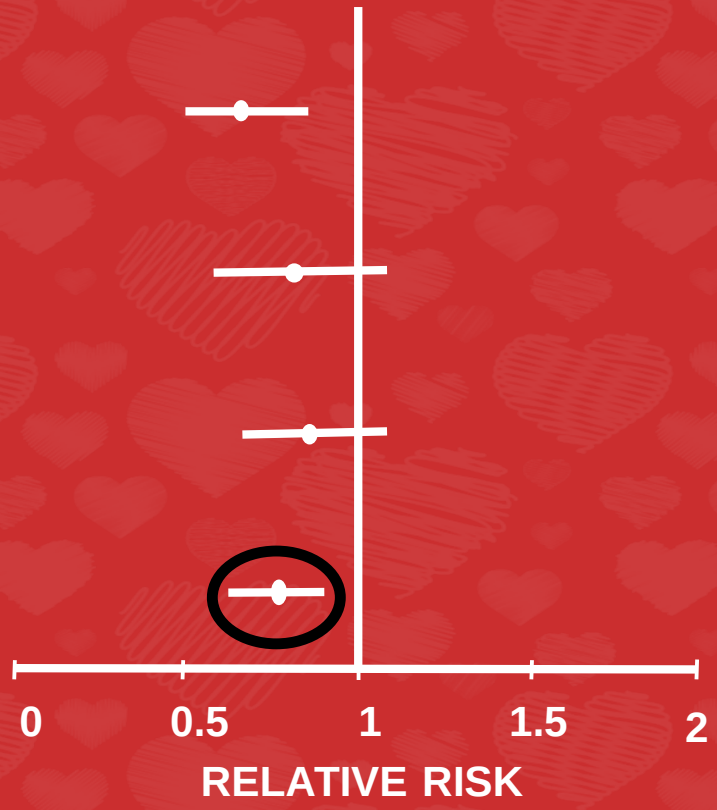
Al-Khatib et al. 2017 VA/SCD Guideline
JACC VOL. 72, NO. 14, 2018 OCTOBER 2, 2018:e91–220


Randomized clinical trials
MADIT
AVID, CABG-Patch
MUSTT
CASH, CIDS
MADIT-II
DEFINITE
DINAMIT
SCD-HeFT
1995
2005

ICD Secondary Prevention Randomized Trials

ALL-CAUSE MORTALITY – ICD vs. AMIODARONE

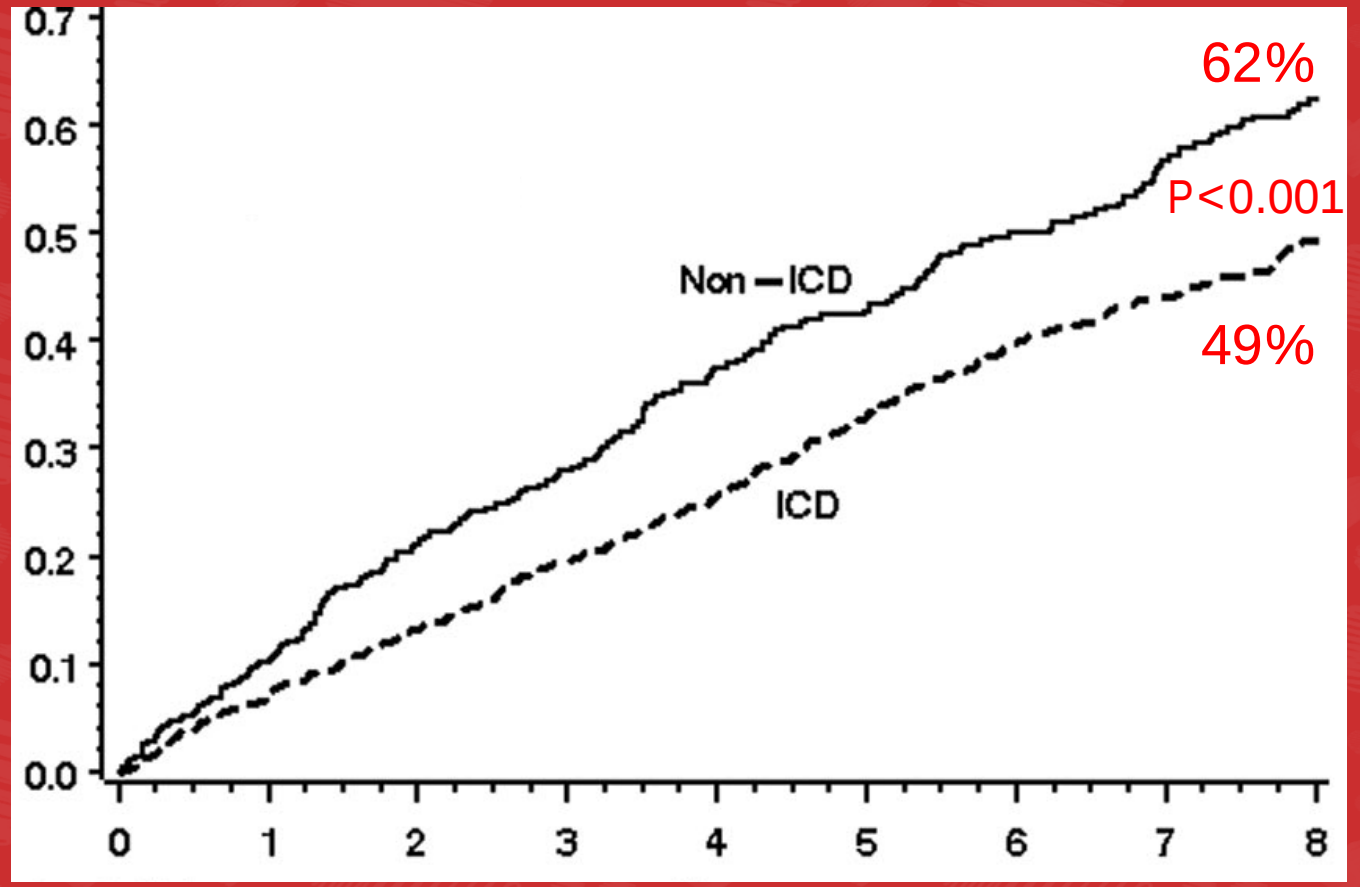
STUDY	N	RR (95% CI)
AVID	1016	0.66 (0.51-0.85)
CASH	288	0.82 (0.60-1.11)
CIDS	659	0.85 (0.67-1.10)
OVERALL	1866	0.76 (0.65-0.89)



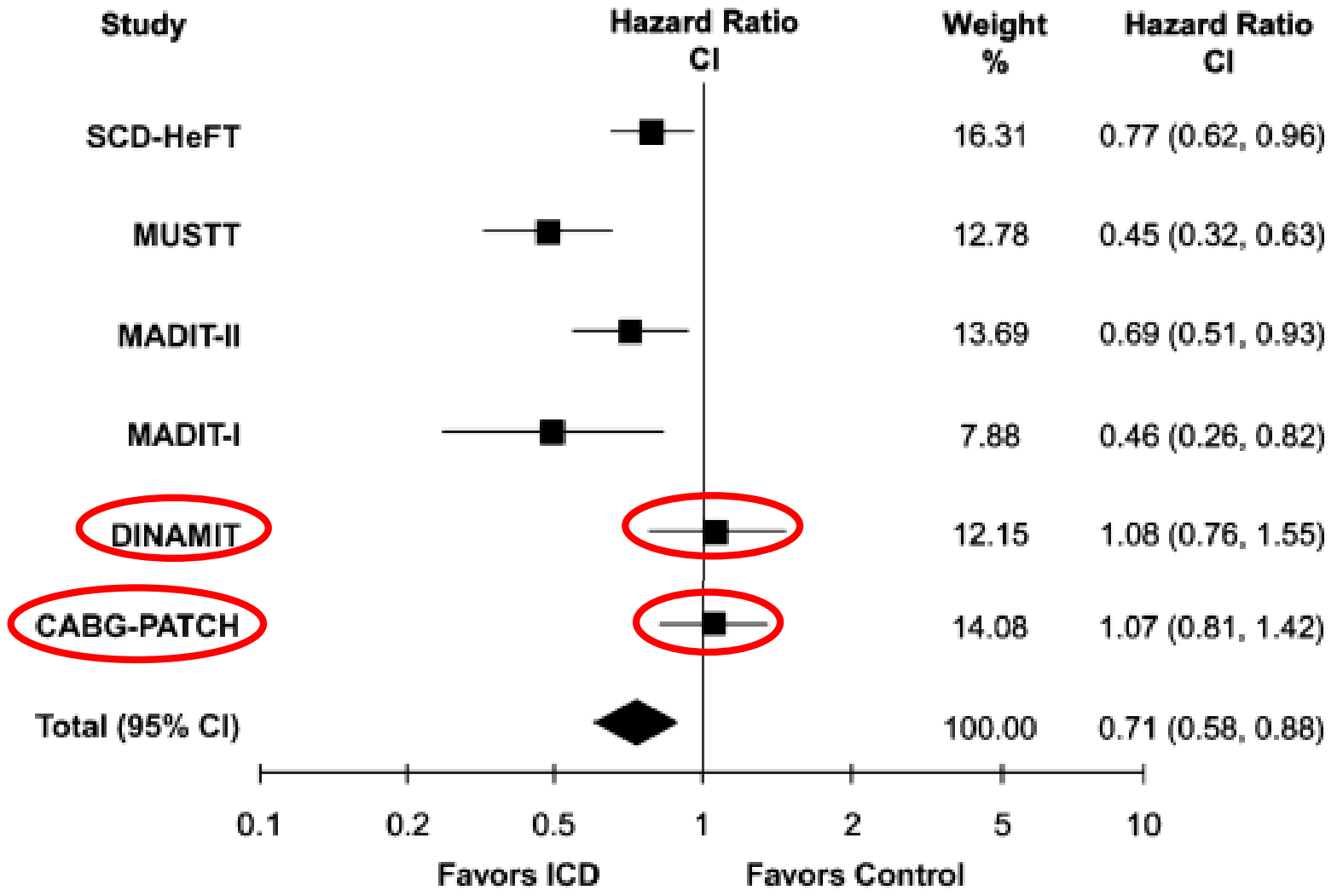
Primary Prevention Trials Demonstrating Benefit in Post-MI Patients

Trial (Follow-Up) Year Published	Number of Subjects	Study Group/Entry Criteria	All-Cause Mortality RRR	ARR
MADIT (2-yr analysis) 1996	196	Prior MI, EF ≤ 35%, NS VT, inducible VT, failed IV PA	59%	19%
MUSTT (5-yr analysis) 1999	659	CAD (prior MI ~95%), EF ≤ 40%, NSVT, inducible VT EP-guided: AAD vs ICD	58%	31%
MADIT-II (2-yr analysis) 2002	1232	Prior MI (>1 month), EF≤30%	28%	6%
SCD-HeFT (5-yr analysis) 2005	2521	NYHA functional class II–III CHF, EF ≤ 35%	23%	7%

MADIT-II:
8-Year Follow-Up



Circulation **2010;122:1265-1271**



Am Heart J. 2005 Jun;149(6):1020-34

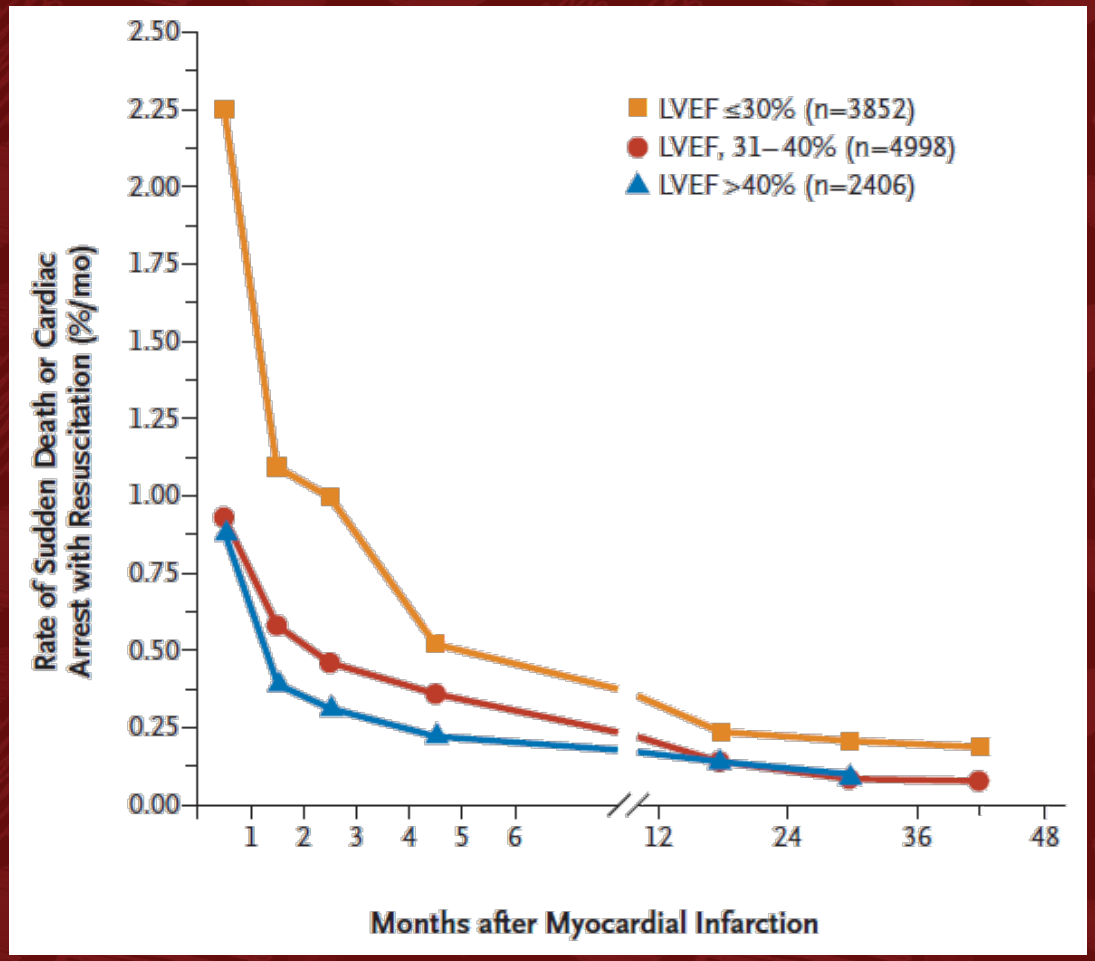
ICD Primary Prevention Randomized Trials

Study	LVEF
MADIT	≤ 35%
CABG-Patch	≤ 36%
MUSTT	≤ 40%
MADIT II	≤ 30%
CAT	≤ 30%
AMIOVIRT	≤ 35%
DEFINITE	≤ 35%
DINAMIT	≤ 35%
COMPANION	≤ 35%
SCD-HeFT	≤ 35%

LVEF $\leq$ 35%

VALIANT Trial

High Early Risk of Sudden Cardiac Arrest

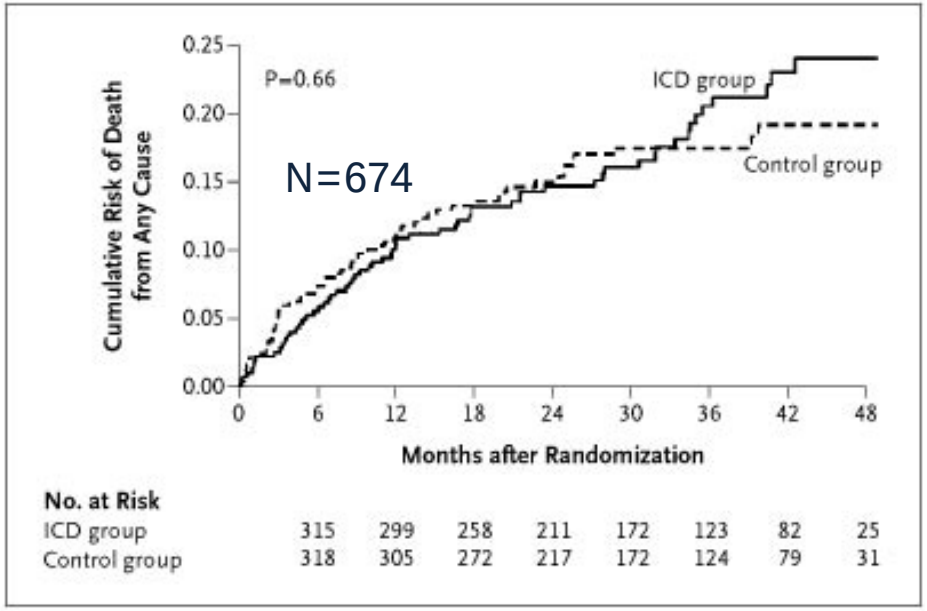


- The risk of SCD post-MI is the highest in the first 30 days[1]
- Post-MI patients with heart failure are at 4-6 times greater risk of SCD in the first 30 days after MI
- 83% of SCA occurred after hospital discharge.
- 74% of those resuscitated in the first 30 days were alive at 1 year

[1] *Solomon SD, et al. Sudden Death in Patients with Myocardial Infarction and Left Ventricular Dysfunction, Heart Failure, or Both. NEJM 2005; 352: 2581-2588.*

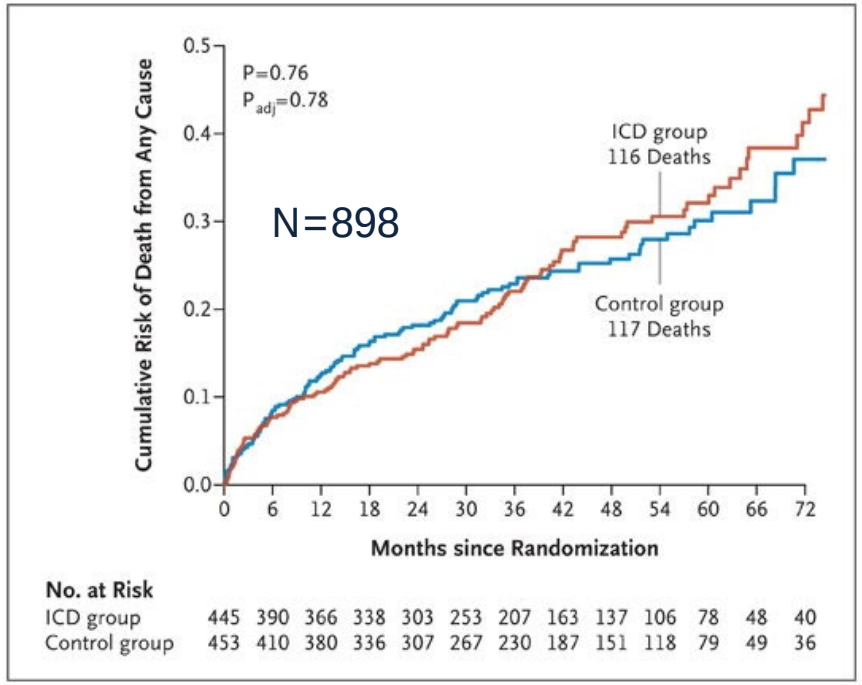
ICD Implantation Early Post-MI

DINAMIT



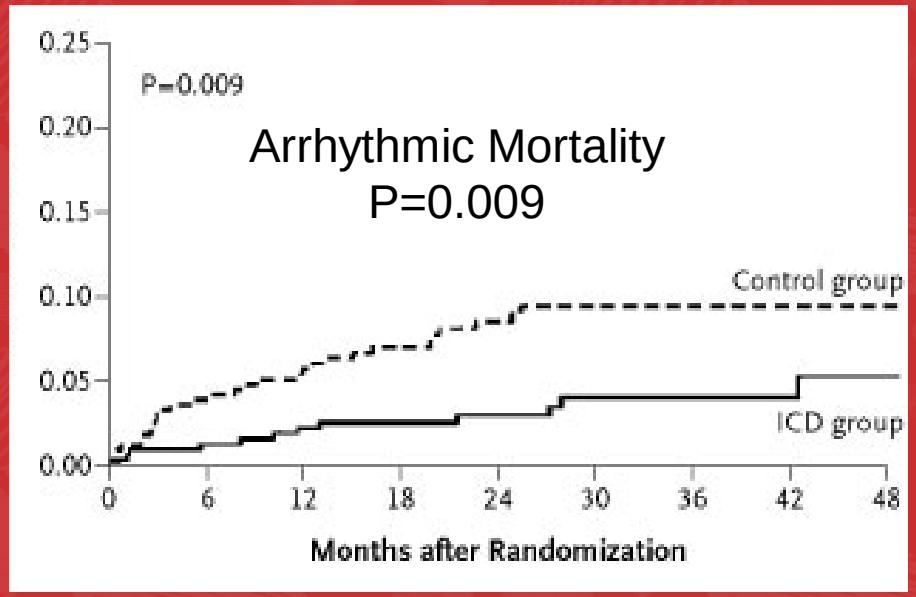
Hohnloser SH et al. N Engl J Med 2004;351:2481-2488.

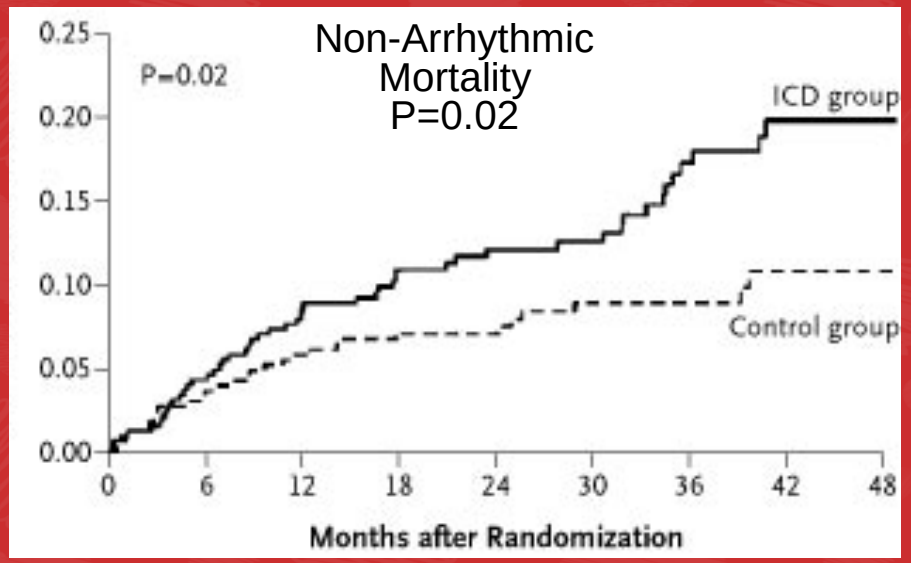
IRIS



Steinbeck G et al. N Engl J Med 2009;361:1427-1436.

DINAMIT





Hohnloser SH et al. N Engl J Med 2004;351:2481-2488.

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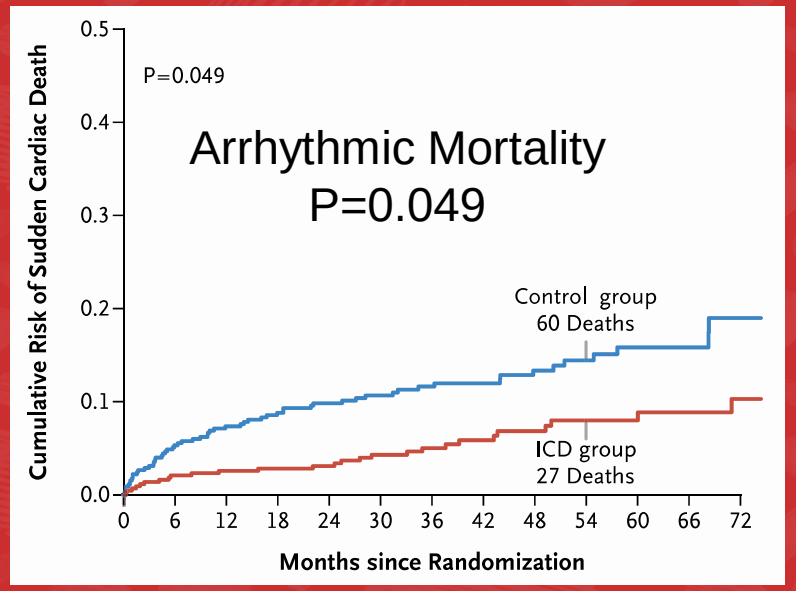
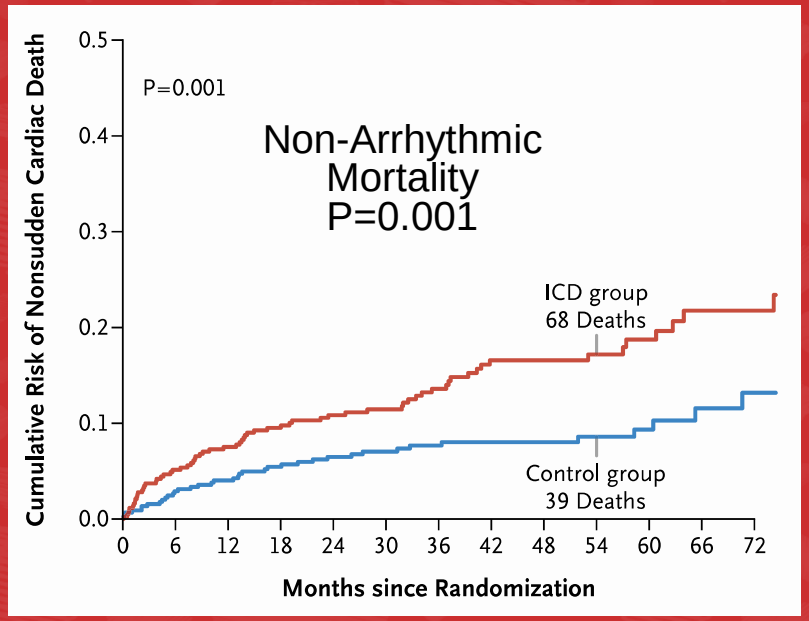




Steinbeck G et al. N Engl J Med 2009;361:1427-1436.

Ischemic Heart Disease

Primary Prevention of SCD in Patients With Ischemic Heart Disease

COR	LOE	Recommendations for Primary Prevention of SCD in Patients With Ischemic Heart Disease
I	A	1. In patients with LVEF of 35% or less that is due to ischemic heart disease who are at least 40 days post-MI and at least 90 days post-revascularization, and with NYHA class II or III HF despite GDMT, an ICD is recommended if meaningful survival of greater than 1 year is expected.

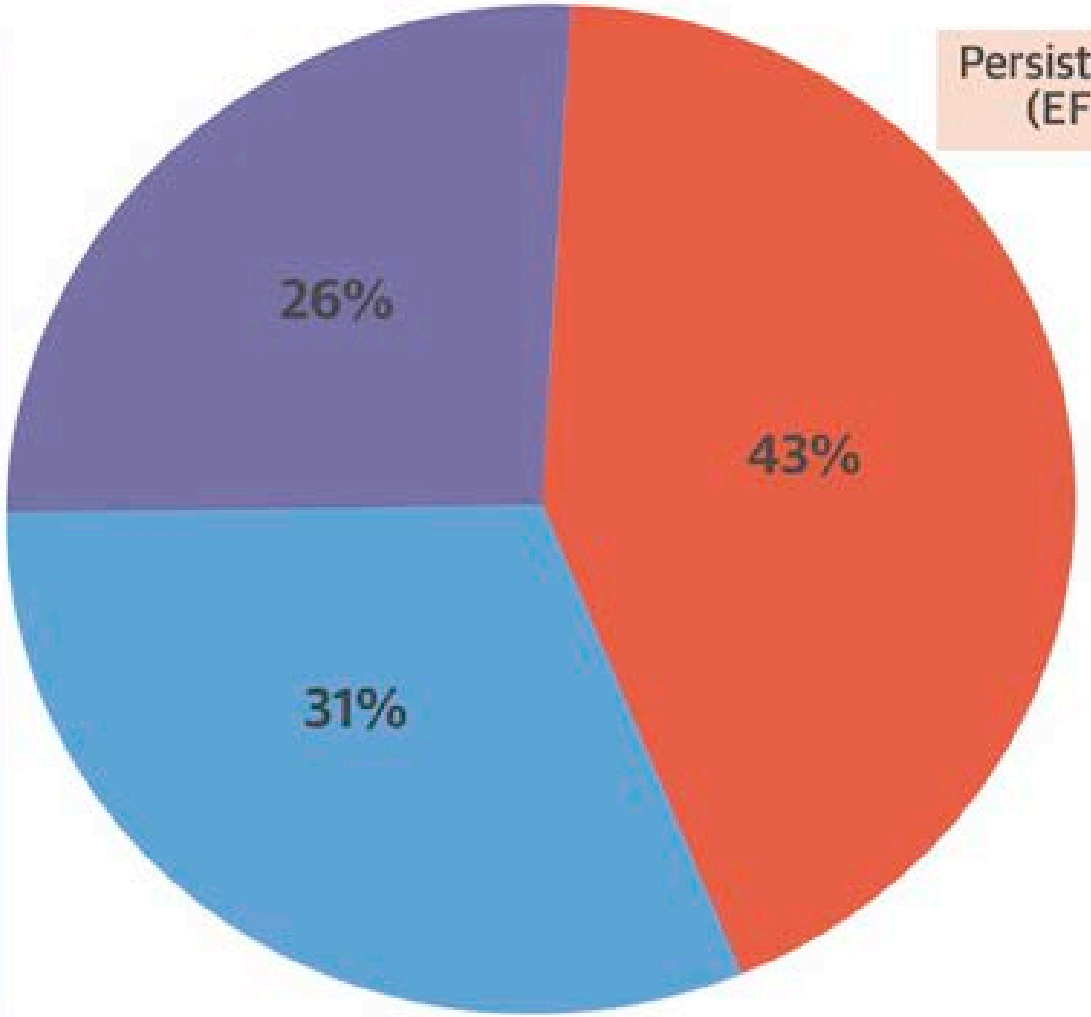
2017 AHA/ACC/HRS Guideline for Management of Patients With Ventricular Arrhythmias and the Prevention of Sudden Cardiac Death

LVEF Improvement After MI

PREDICTS

Near Normal
(EF ≥ 50%)
Predictors:
- Higher EF at Presentation
- Female
- Lower Peak Troponin
- No Prior MI
- VF or Arrest at Presentation

Partial Recovery
(EF 36%-49%)
Predictors:
- Higher EF at Presentation
- Length of Stay ≤ 4 Days
- No Prior MI
- No Lateral WMA
- Glucose < 100 at Presentation
- Lower Peak Troponin



Brooks, et al. J Am Coll Cardiol. 2016;67:1186

The NEW ENGLAND JOURNAL of MEDICINE

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Wearable Cardioverter–Defibrillator after Myocardial Infarction

Jeffrey E. Olgin, M.D., Mark J. Pletcher, M.D., M.P.H., Eric Vittinghoff, Ph.D., Jerzy Wranicz, M.D., Ph.D., Rajesh Malik, M.D., Daniel P. Morin, M.D., M.P.H., Steven Zweibel, M.D., Alfred E. Buxton, M.D., Claude S. Elayi, M.D., Eugene H. Chung, M.D., Eric Rashba, M.D., Martin Borggrefe, M.D., Ph.D., Trisha F. Hue, Ph.D., M.P.H., Carol Maguire, R.N., Feng Lin, M.S., Joel A. Simon, M.D., M.P.H., Stephen Hulley, M.D., M.P.H., and Byron K. Lee, M.D., M.A.S., for the VEST Investigators*

N Engl J Med 2018;379:1205-15.
DOI: 10.1056/NEJMoa1800781

VEST Rationale

1. ICD not indicated in immediate post-MI period

2. Some early mortality not due to arrhythmias immediately post-MI, thus not preventable by ICD

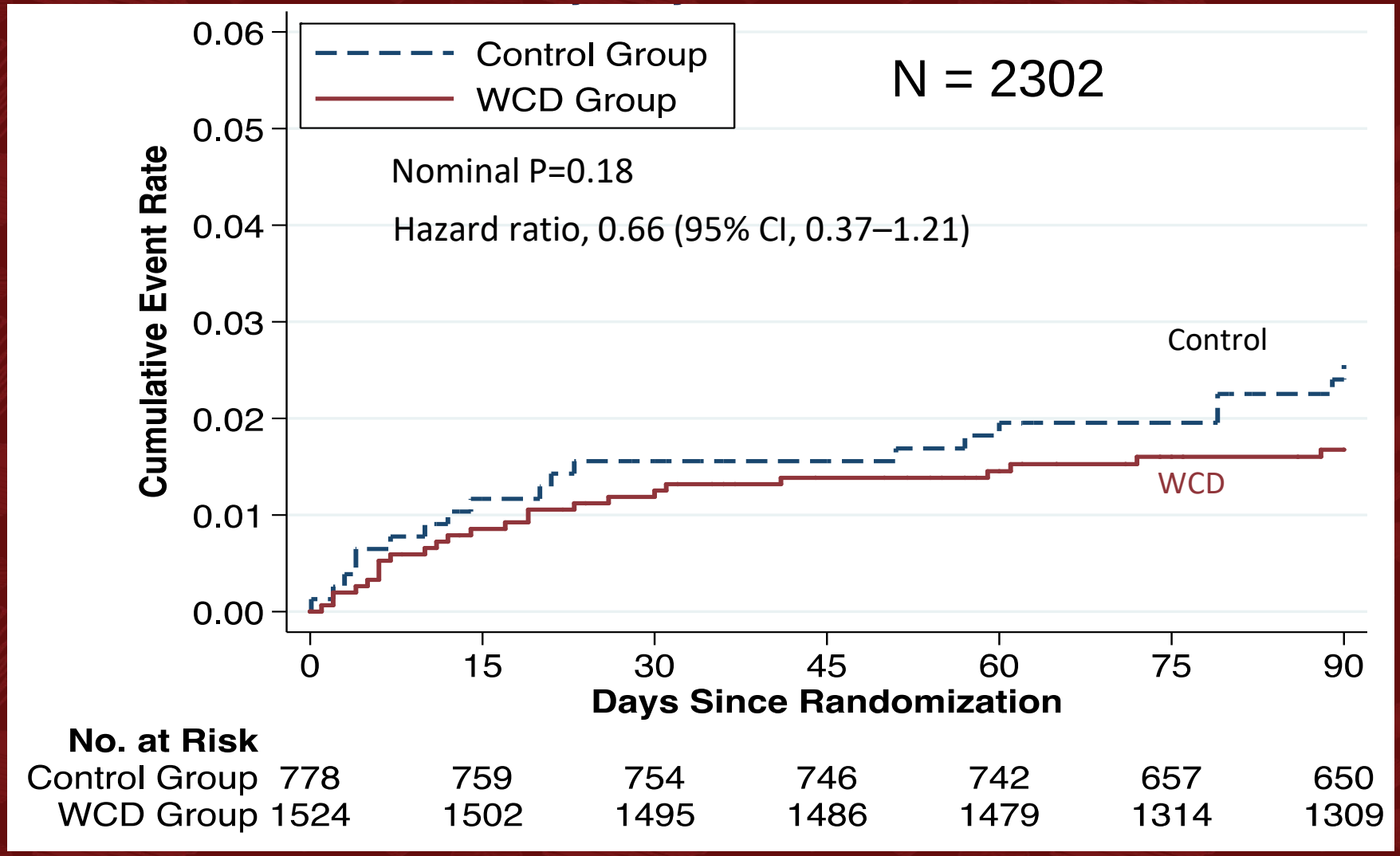
3. LVEF may recover over 3 months post-MI

Can a wearable cardioverter defibrillator (WCD) reduce SD mortality in the immediate post-MI period (<90 days) in patients with reduced LVEF, as a bridge to evaluation for ICD?

VEST: Study Design

- Multi-center, randomized, open-label trial
- Participants enrolled within 7 days of hospital d/c with acute MI and LVEF≤35%
- Slow enrollment → primary endpoint changed to sudden death or death due to ventricular arrhythmia to decrease required sample size to 2,000 (and then later to 2,300)
  Total mortality became secondary endpoint
- Crossovers & ICDs prohibited (except for secondary prevention during follow-up)
- Initial primary endpoint: total mortality
- Initial sample size: 4,500

Primary Endpoint:
Sudden + Ventricular Tachyarrhythmia Death

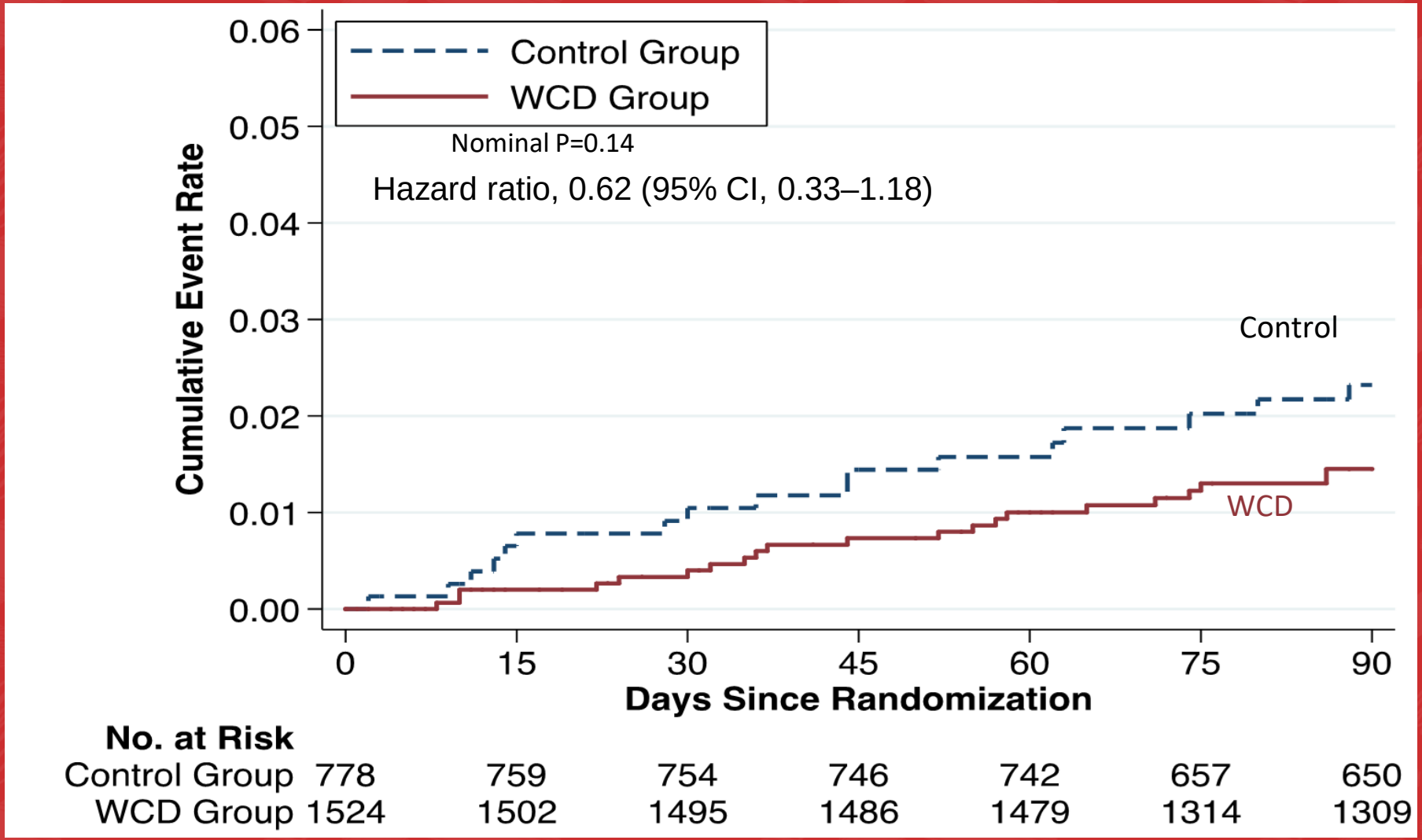


No. at Risk

Control Group	778	759	754	746	742	657	650
WCD Group	1524	1502	1495	1486	1479	1314	1309

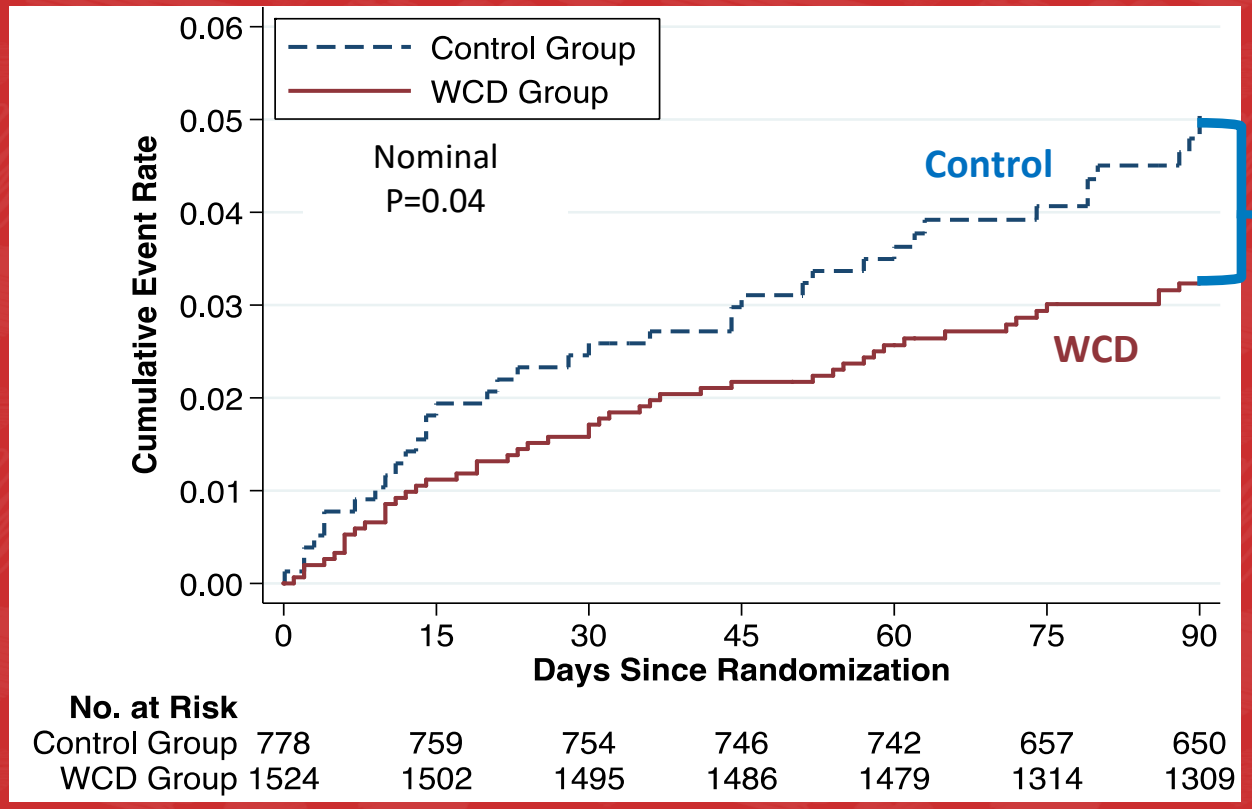
N Engl J Med 2018;379:1205-15.

Secondary Endpoint: Non-Sudden Death



N Engl J Med 2018;379:1205-15.

Secondary Endpoint: Death from Any Cause



36% Relative Risk Reduction in Total Mortality at 90 days

3.1% of the participants died during follow-up in the WCD group compared to 4.9% in the control group, resulting in an absolute risk reduction of 1.8% in the WCD group.

N Engl J Med 2018;379:1205-15.


LOVERS
AT
HEART

“Statistics are like bikinis. What they reveal is suggestive, but what they conceal is vital.”
— **Aaron Levenstein**

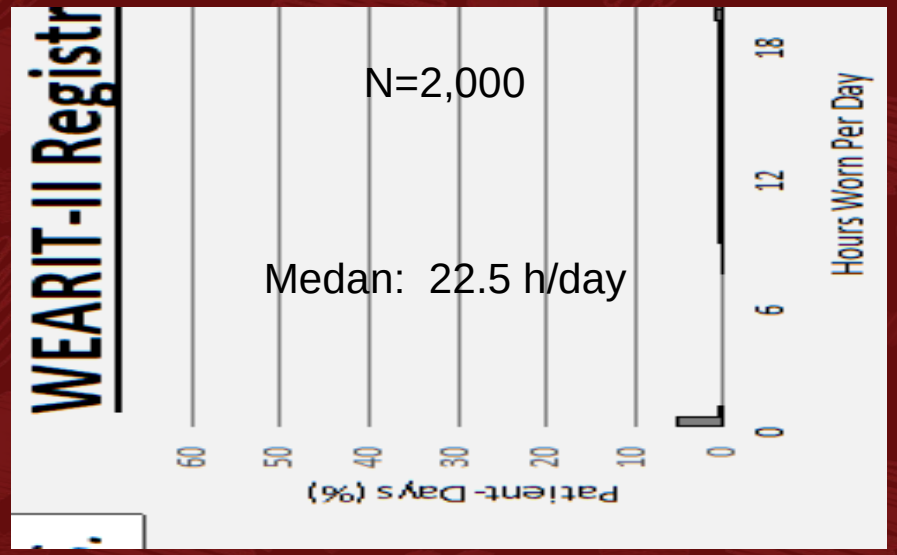
Total Mortality vs. Sudden Death

- Power to detect difference in sudden death: 75%
- Possible misclassification of sudden deaths
  - 5% of death adjudicated as indeterminate
  - Reducing power for sudden death outcome, but not total mortality

- WCD may confer additional protection from mortality
  - Increased adherence with medical therapy
  - More likely to return for follow-up

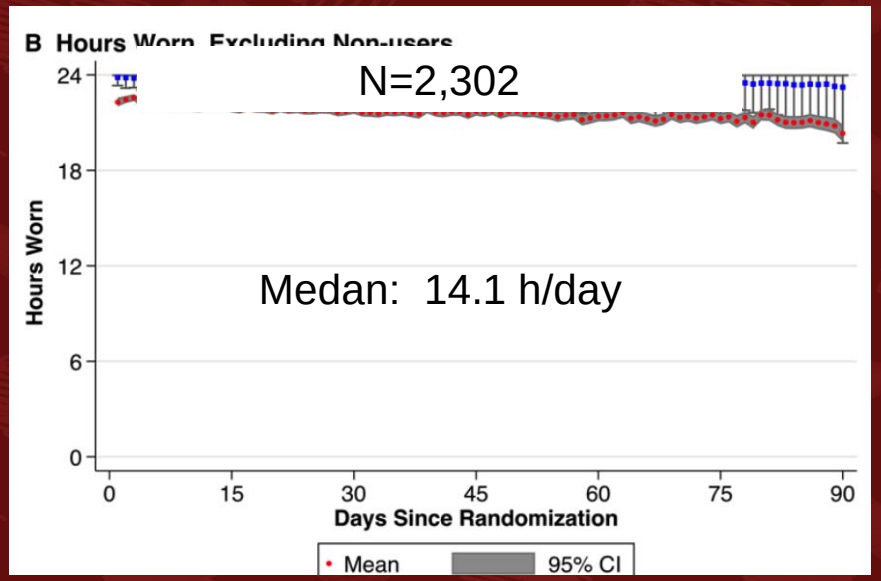
WCD Wear-time: WEARIT II vs VEST

WEARIT-II



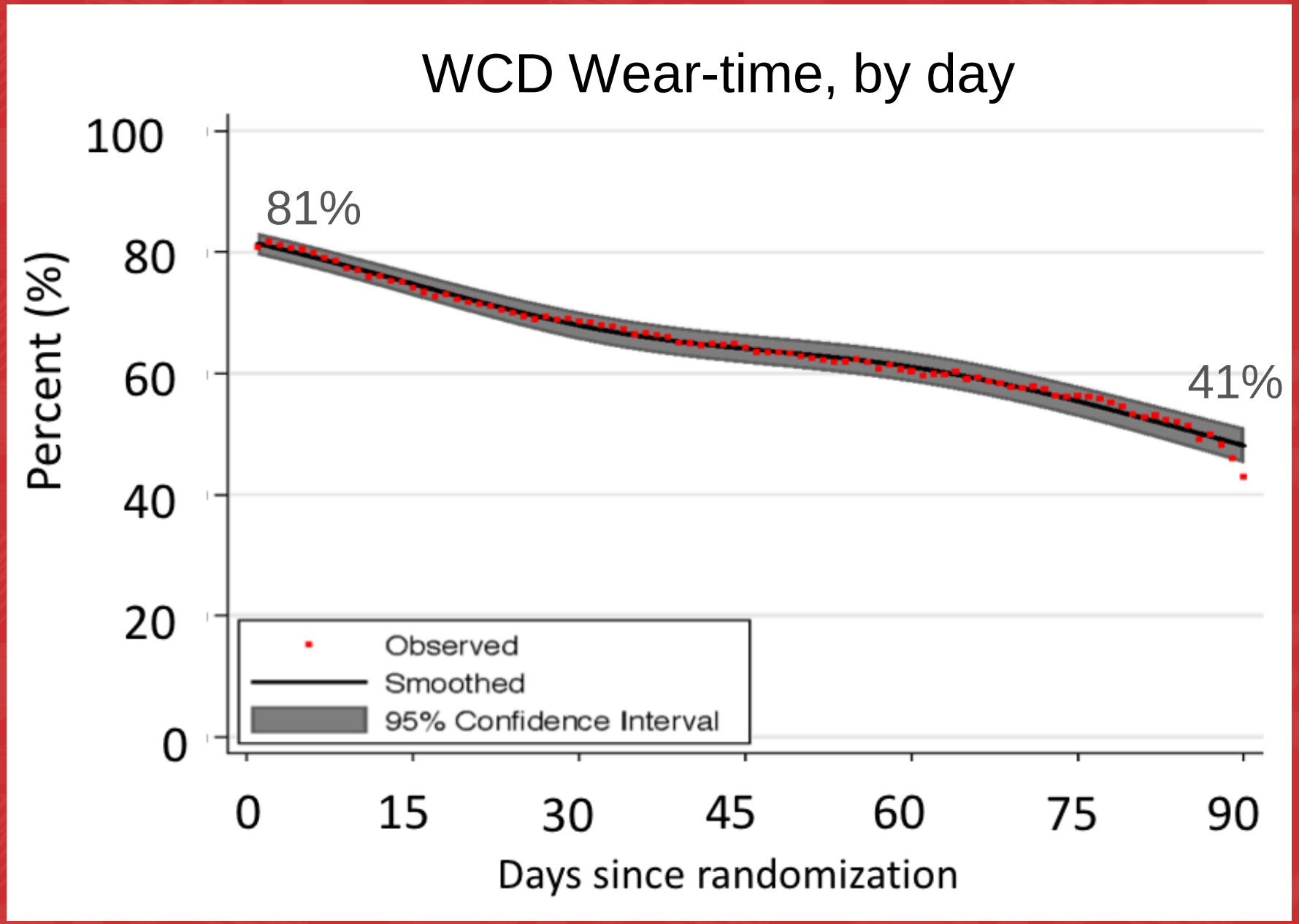
Circulation. 2015;132:1613-1619.

VEST



N Engl J Med 2018;379:1205-15. Supplement

Effect of equipoise at randomization?



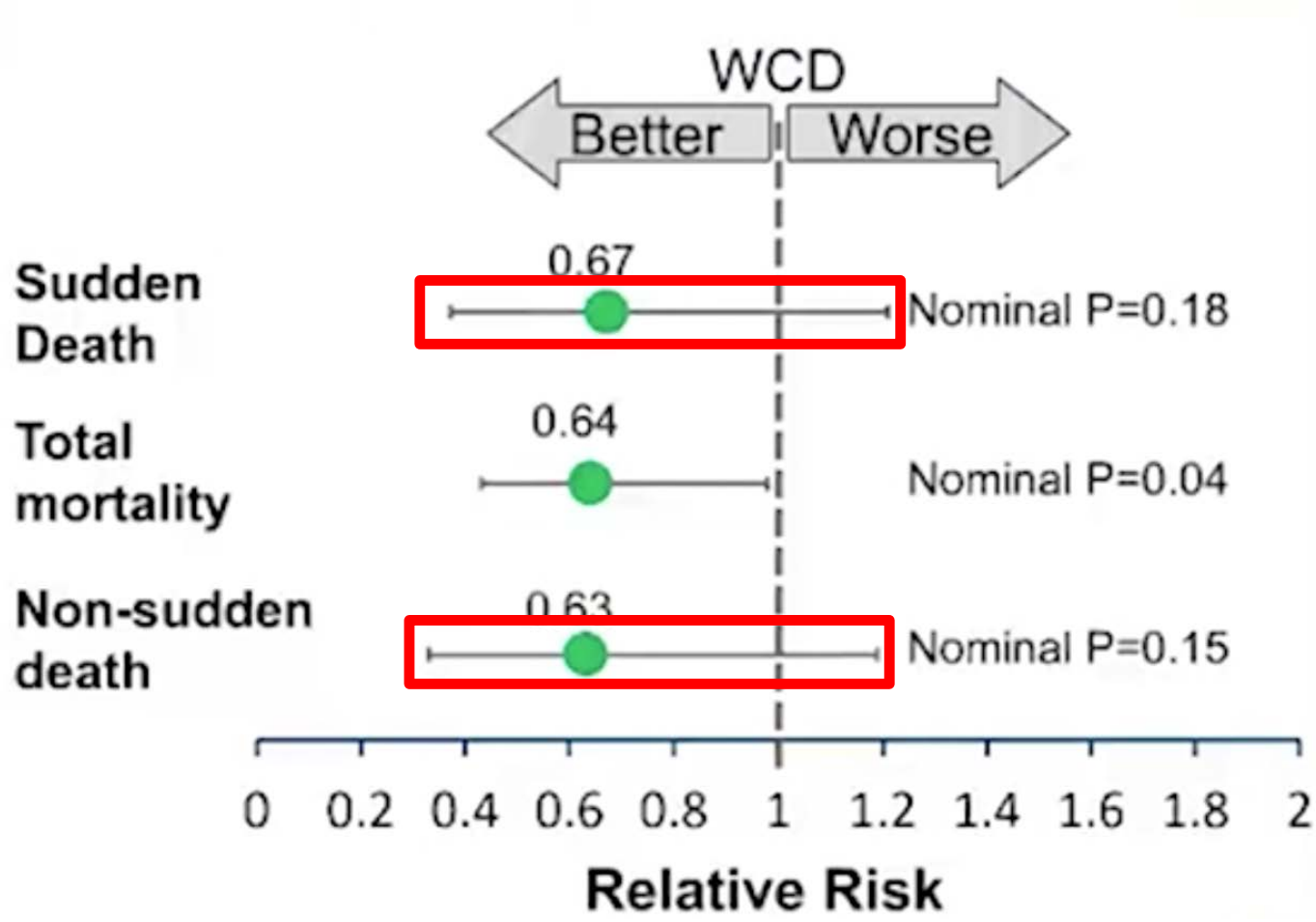
N Engl J Med 2018;379:1205-15.Supplement

VEST Trial: Crossover

Characteristic	WCD Group (N=1524)	Control Group (N=778)
WCD received, n (%)	**1481 (97.2%)**	20 (2.6%)*
Median hours/day WCD worn [IQR]	**18** [3.8-22.7]	0 [0-0]*
Average hours/day WCD worn ± SD	**14.0 ± 9.3**	0.4 ± 2.7*
ICD during follow up (<90 days), n (%)	67 (4.4%)	44 (5.7%)
ICD Implant timing (days since randomization), median [IQR]	62 [24-81]	58 [25-77]

*P <0.001

VEST RESULTS



Results: Sudden Deaths in WCD Group

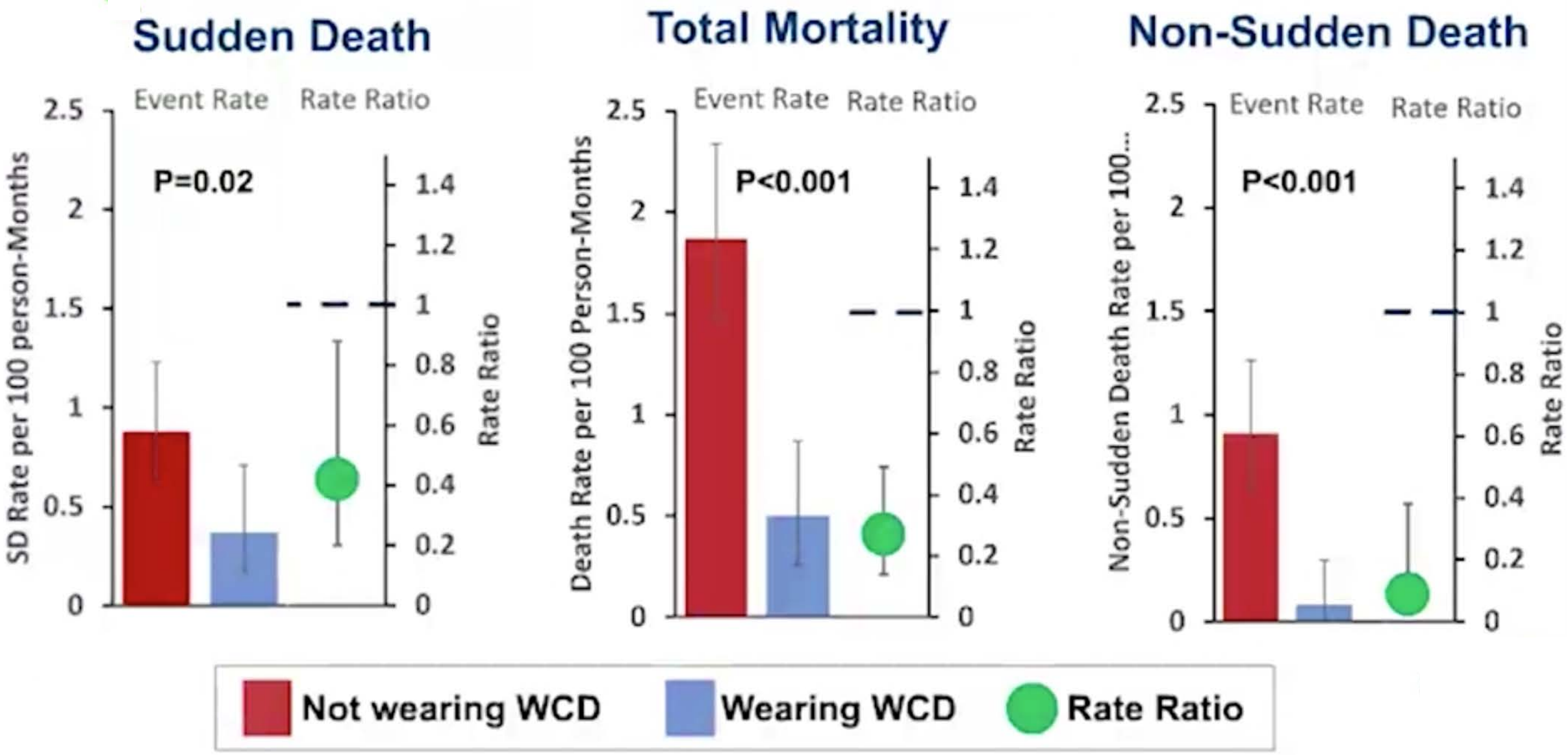
- 16/25 sudden deaths in WCD group were not wearing WCD at time of death
  - Prolonged wear time might have changed outcome of trial
- 4/9 sudden deaths wearing the WCD had initial ventricular tachyarrhythmias successfully treated by WCD, but then died from recurrent ventricular tachy-arrhythmias or agonal rhythms.

Results:
WCD Therapies and Events

- 21 Participants (1 in control group) with appropriate shocks.
  - All converted to sinus rhythm
  - 15 survived to 90 days, suggesting some benefit of WCD
  - 6 died (all WCD group)

- 9 inappropriate shocks in WCD group, none in control group
- 70 patients with aborted shock
  - Many shocks delayed or averted appropriate therapies.

Results: On-Treatment Analysis



VEST Trial Investigator Conclusions:

- In post-MI patient with LVEF ≤ 35% for the first 90 days:
  - The WCD is associated with a 33% decrease in sudden death mortality, (p=0.18), our primary outcome.
  - The WCD is associated with a 37% decrease in non-sudden death mortality (p=0.14).
  - The WCD is associated with a 36% decrease in total mortality, (p=0.04).
- WCD is associated with large risk reduction of all mortality outcomes in as-treated analysis.
- For motivated high risk patients, the WCD is still a reasonable option

Comparing VEST to the NNT for some other CV therapies...

ASA to prevent events in known CAD/PAD: 50

VEST demonstrated a 1.8% absolute risk reduction in all-cause mortality for the WCD. This correlates with a number needed to treat of 55.6 to prevent one death...

- Heart attack: 100

Statins to save one life: 83

Rapid Defibrillation for cardiac arrest: 2.5 to prevent one death

AT 90 DAYS!!!

www.thennt.com

Wearable Cardioverter-Defibrillator

COR	LOE	Recommendations for Wearable Cardioverter-Defibrillator
IIa	B-NR	1. In patients with an ICD and a history of SCA or sustained VA in whom removal of the ICD is required (as with infection), the wearable cardioverter-defibrillator is reasonable for the prevention of SCD
IIb	B-NR	2. In patients at an increased risk of SCD but who are not ineligible for an ICD, such as awaiting cardiac transplant, having an LVEF of 35% or less and are within 40 days from an MI, or have newly diagnosed NICM, revascularization within the past 90 days, myocarditis or secondary cardiomyopathy or a systemic infection, wearable cardioverter-defibrillator may be reasonable.

2017 AHA/ACC/HRS Guideline for Management of Patients With Ventricular Arrhythmias and the Prevention of Sudden Cardiac Death

Back to our case…

82 yo man with HTN, DM, dyslipidemia:

- 12/5/19 Inferior STEMI in OKC
  - s/p PCI/DES to culprit RCA
  - LCx occluded proximally
  - Residual diffuse 80-90% mLAD disease
- 12/11/19 NSTEMI → complex PCI of LAD
- 12/12/19 Echo: LVEF 30-35%
- 12/13/19 Ready for hospital discharge
  - On GDMT with ASA/ticagrelor, atorvastatin, carvedilol, and lisinopril

In addition to GDMT, what would you do next?

A. Reassess LVEF in 40 days to assess ICD candidacy.

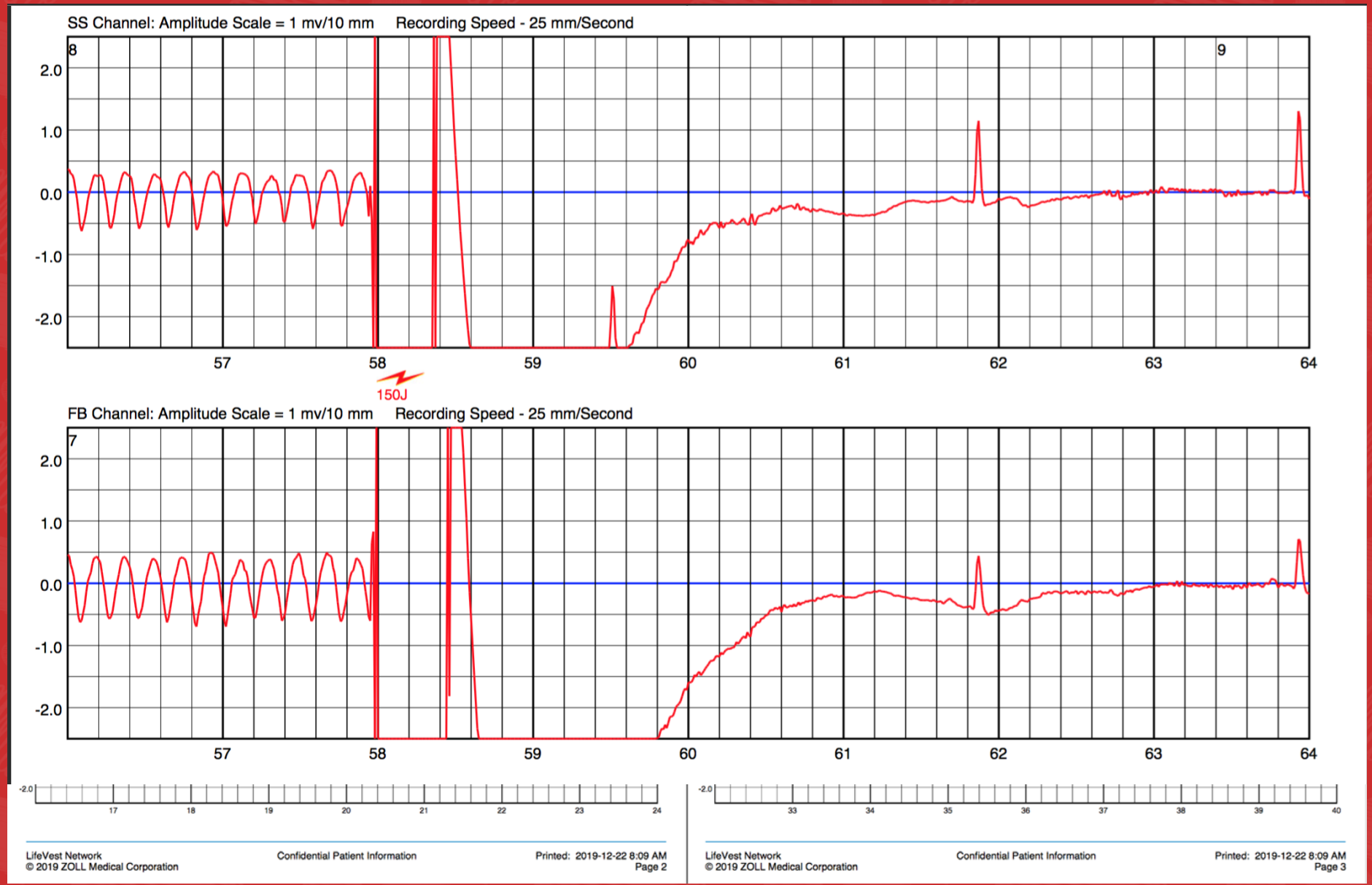
B. Reassess LVEF in 90 days to assess ICD candidacy.

C. Offer a wearable cardioverter-defibrillator (WCD) as a bridge while waiting to re-assess LVEF in 90 days.

D. Implant a transvenous ICD for primary prevention of sudden death.

E. Implant a subcutaneous defibrillator for the primary prevention of sudden cardiac death.

On 12/21/19 (8 days after hospital d/c):



My WCD Approach

- Does the patient already have an indication for an ICD? Or a transient contra-indication for receiving an ICD?
- Is the patient capable of operating the WCD and willing to do so?
- Will the patient be a candidate for ICD implantation in the future?
- Does the patient accept the possibility of undergoing ICD implantation once the waiting period is over?
- Shared decision-making process

Thank You

HEART ELEMENTS