Device Interrogation- Pacemakers, ICD and Loop Recorders

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Device Clinic Coordinator, MHVI

Disclosures

Consultant: Medtronic

Speaker's Bureau: St. Jude Medical

Cardiac Implantable Electronic Devices

Pacemaker

- [x] Battery
- [ ] Capacitor
- [x] Low Voltage
- [ ] High Voltage
- [x] Asystole
- [x] Heart Failure
- [x] Brady Detections
- [x] Brady Therapies
- [x] AT/AF Detections
- [ ] AT/AF Therapies
- [ ] VT/VF Detections
- [ ] VT/VF Therapies

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Cardiac Implantable Electronic Devices

ICD

- [x] Battery
- [x] Capacitor
- [x] Low Voltage
- [x] High Voltage
- [x] Asystole
- [x] Heart Failure
- [x] Brady Detections
- [x] Brady Therapies
- [x] AT/AF Detections
- [x] AT/AF Therapies
- [x] VT/VF Detections
- [x] VT/VF Therapies

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Cardiac Implantable Electronic Devices

ILR

☑ Battery	☑ Brady Detections
☐ Capacitor	☐ Brady Therapies
☐ Low Voltage	☑ AT/AF Detections
☐ High Voltage	☐ AT/AF Therapies
☑ Asystole	☑ VT/VF Detections
☐ Heart Failure	☐ VT/VF Therapies

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Cardiac Implantable Electronic Devices

Trends

- ICDs: Expanding Indications for implantation

- Pacemaker: Increasing co-morbid conditions

Expanding Indications

- *2006 ACC/AHA/ESC Guidelines for Management of Patients with Ventricular Arrhythmias and the Prevention of Sudden Cardiac Death.* Circulation. 2006;**114**:1088–1132
- *2008 ACC/AHA/HRS Guidelines for Device-Based Therapy.* Circulation. 2008;**117**:2820–2840
- *2013 ACC/AHA Guideline for the Management of Heart Failure.* Circulation. 2013;**128**:e240–e327
- *2013 ACC/AHA Guideline for the Management of ST-Elevation Myocardial Infarction.* Circulation. 2013;**127**:e362–e425

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Expanding Indications

- 2014 HRS/ACC/AHA Expert Consensus Statement on the Use of Implantable Cardioverter-Defibrillator Therapy in Patients Who Are Not Included or Not Well Represented in Clinical Trials
  Circulation. 2014;**130**:94-125

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Charleston Comorbidity Index pacemaker population

CCI >2	1993	2009
VVI	14.1%	45%
DDD	13.5%	42.4%

Greenspon A JACC Vol. 60, No. 16, 2012

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Device Interrogation

Device Clinic:

Clinical and Technical Effectiveness

Safety and Education

Device Interrogation

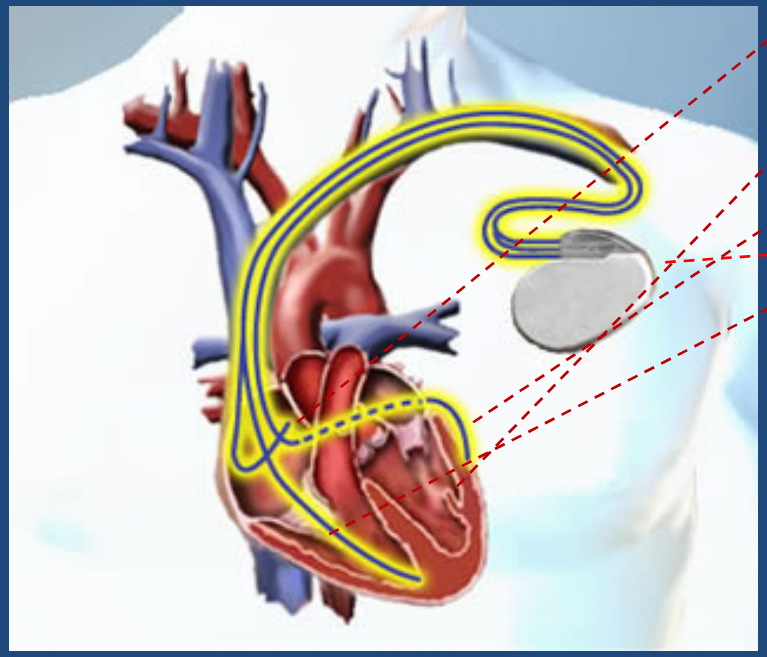
Clinician:

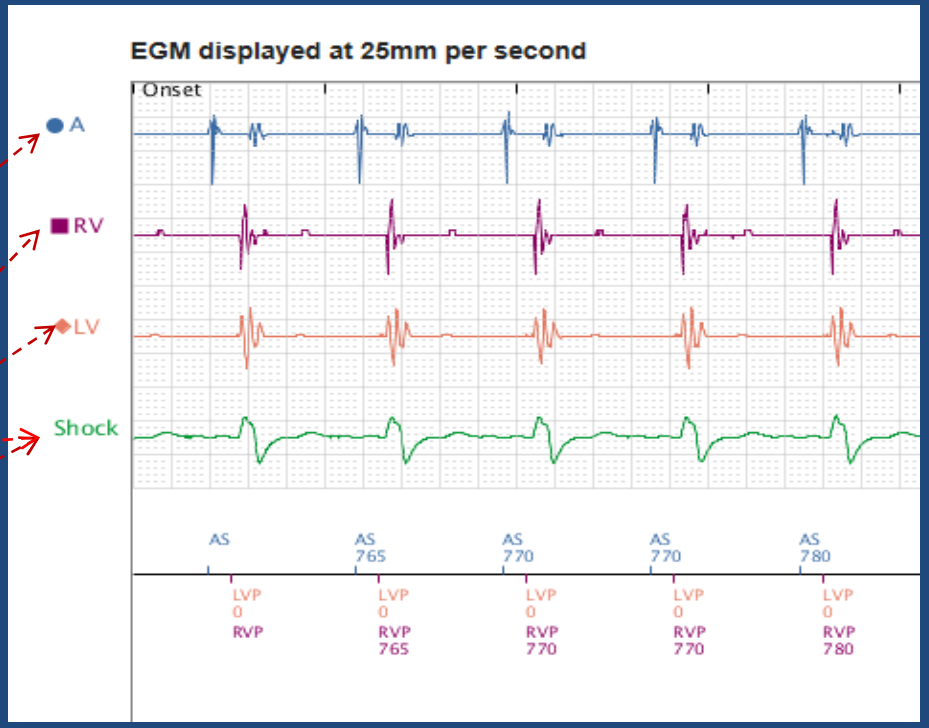
Clinical Effectiveness

Impact on co-morbid conditions

Assessing Clinical effectiveness

Presenting rhythm





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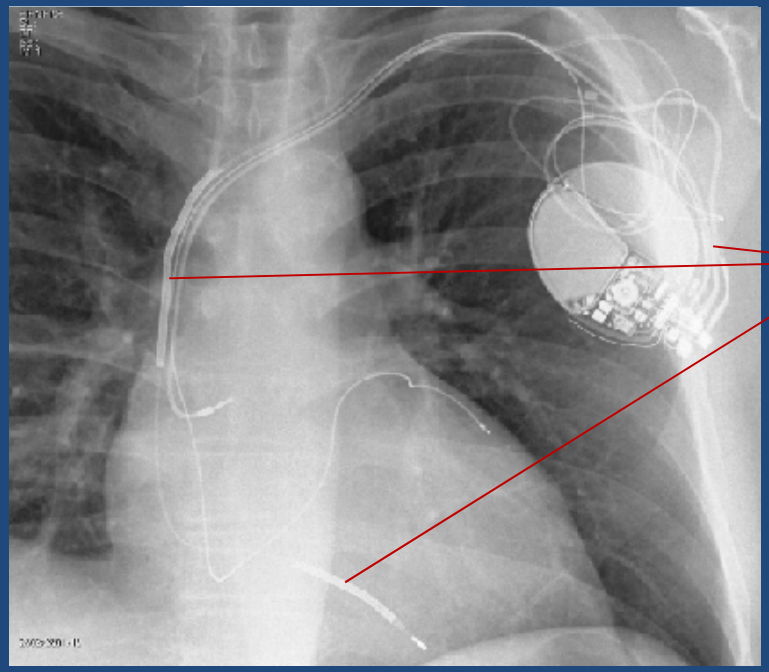
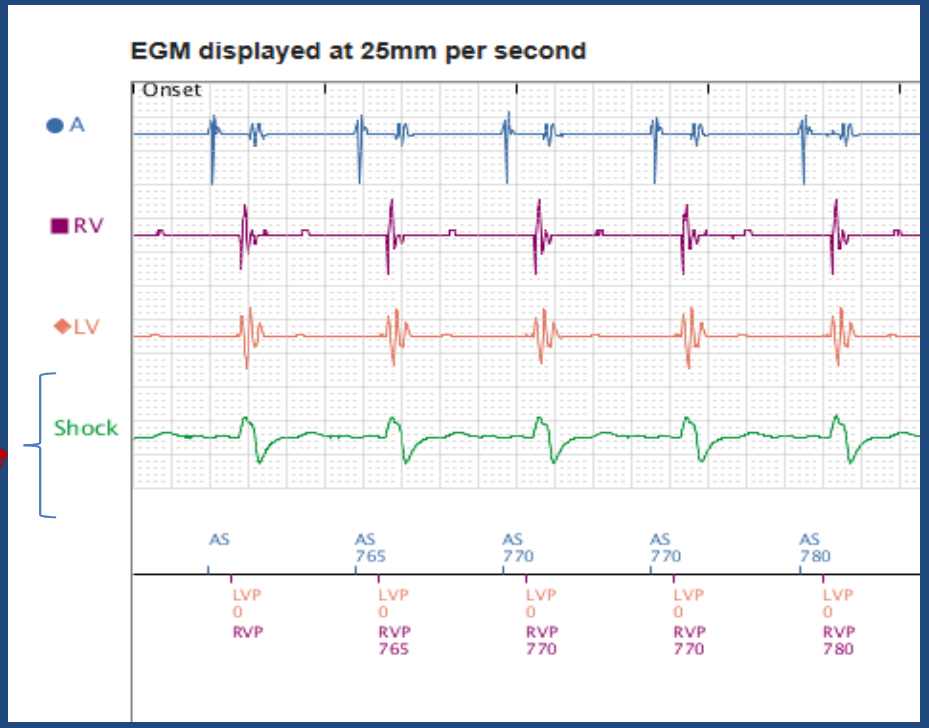
Assessing Clinical effectiveness

Presenting rhythm





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Assessing Clinical effectiveness

Settings (Parameters)

VF	200 bpm	ATP	41 J, 41 J, 41 Jx6
VT	175 bpm	ATP	41 J, 41 J, 41 Jx4
Mode			DDD - BiV
LRL - MTR			70 - 130 ppm
Paced AV Delay			180 - 180 ms
Sensed AV Delay			120 - 120 ms
LV Offset			0 ms

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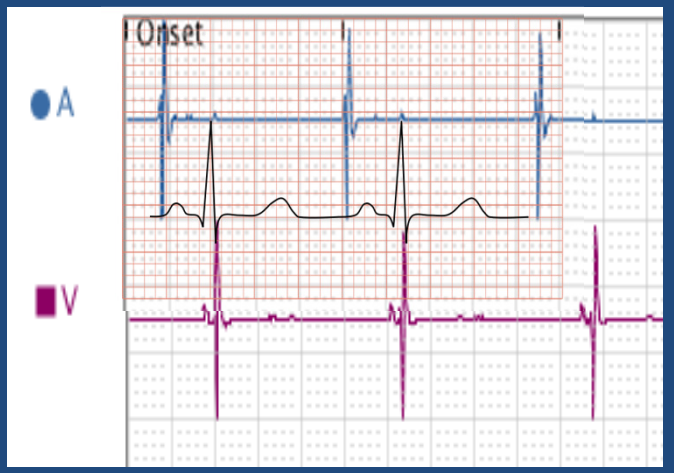
Assessing Clinical effectiveness

Intrinsic amplitude (mV)



P wave: measurement of intrinsic atrial signal

R wave: measurement of intrinsic ventricular signal

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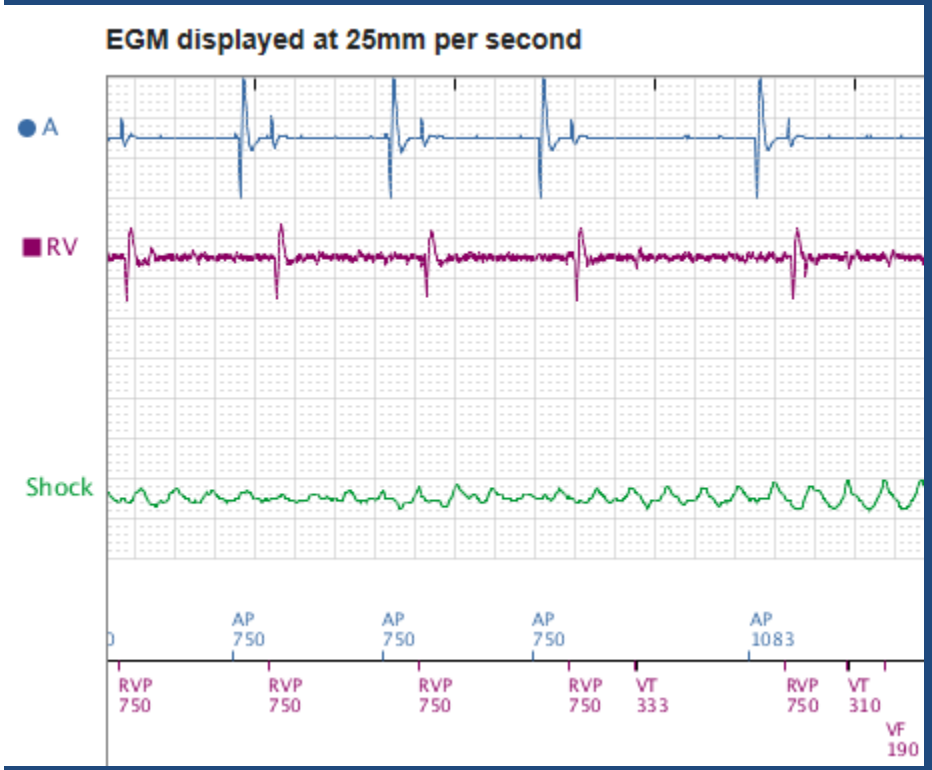
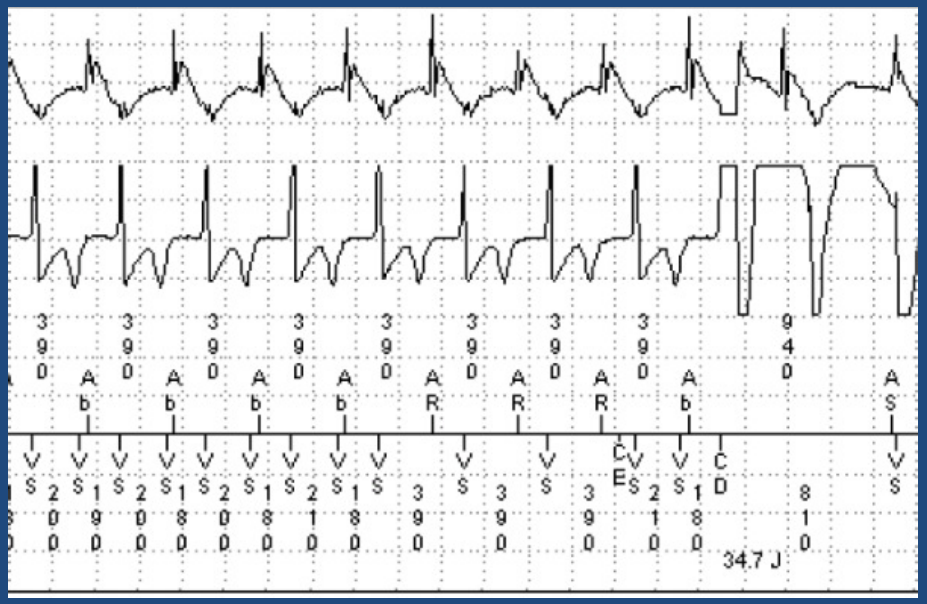
Assessing Clinical effectiveness



Ventricular undersensing



Ventricular oversensing

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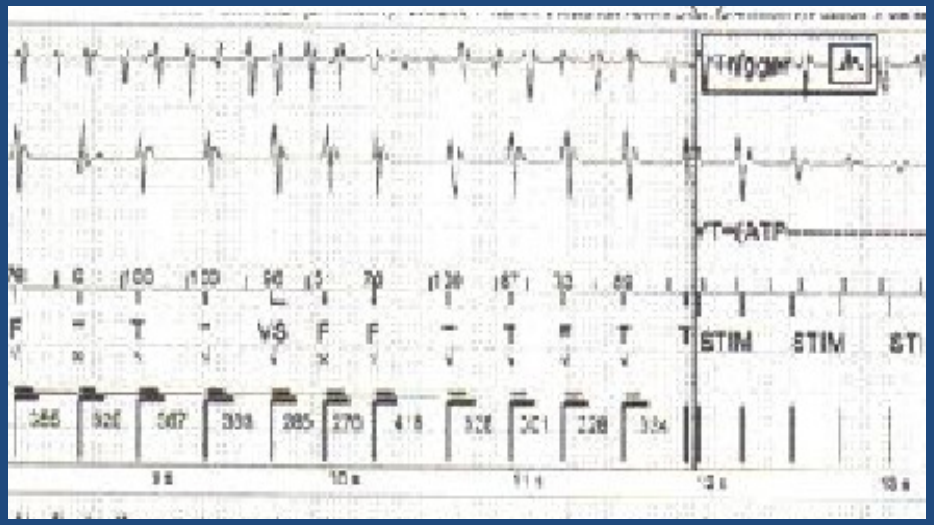
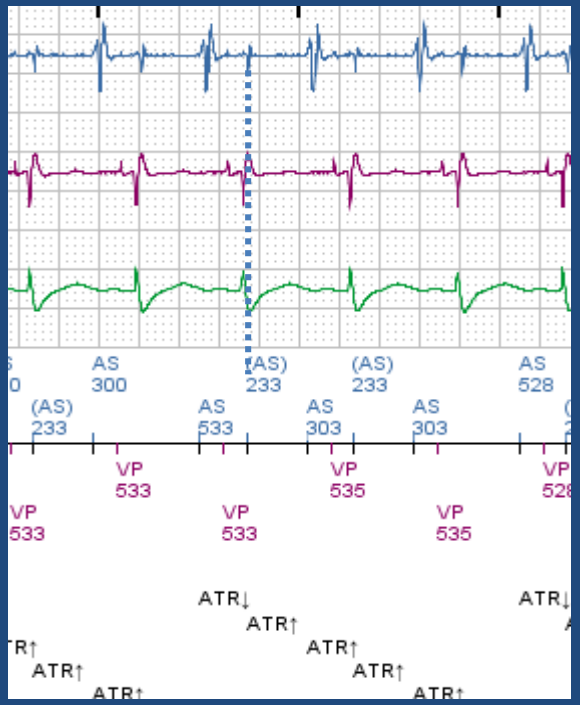
Assessing Clinical effectiveness



Atrial undersensing



Atrial oversensing

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Assessing Clinical effectiveness

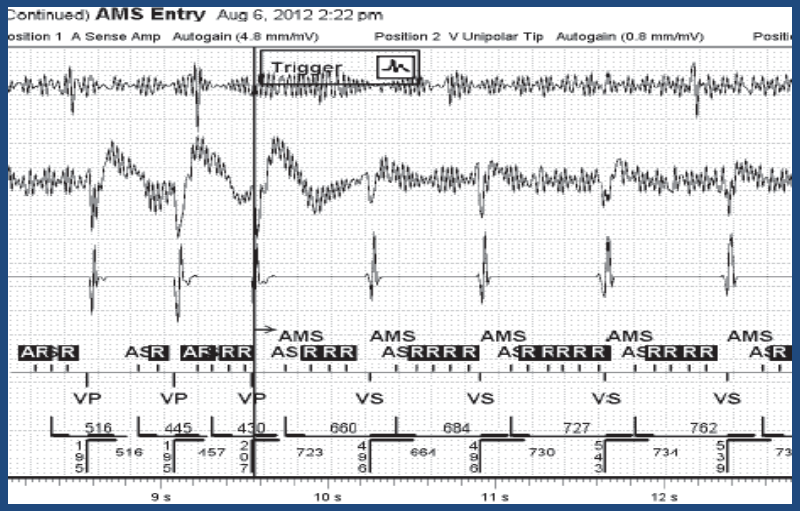
Lead status:

	Fracture	Insulation breach
Threshold	↑↑↑	↑
Impedance	↑↑↑	↓↓↓

Assessing Clinical effectiveness

Lead status:

Lead chatter



EMI

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Assessing Clinical effectiveness

Observations:

- Arrhythmia events
- Percent paced
- Histogram
- Red alert conditions

Assessing Clinical effectiveness

Observations:

Arrhythmia events

- Correlate clinical symptoms to arrhythmia occurrence

- Assess response to antiarrhythmic therapy

Assessing Clinical effectiveness

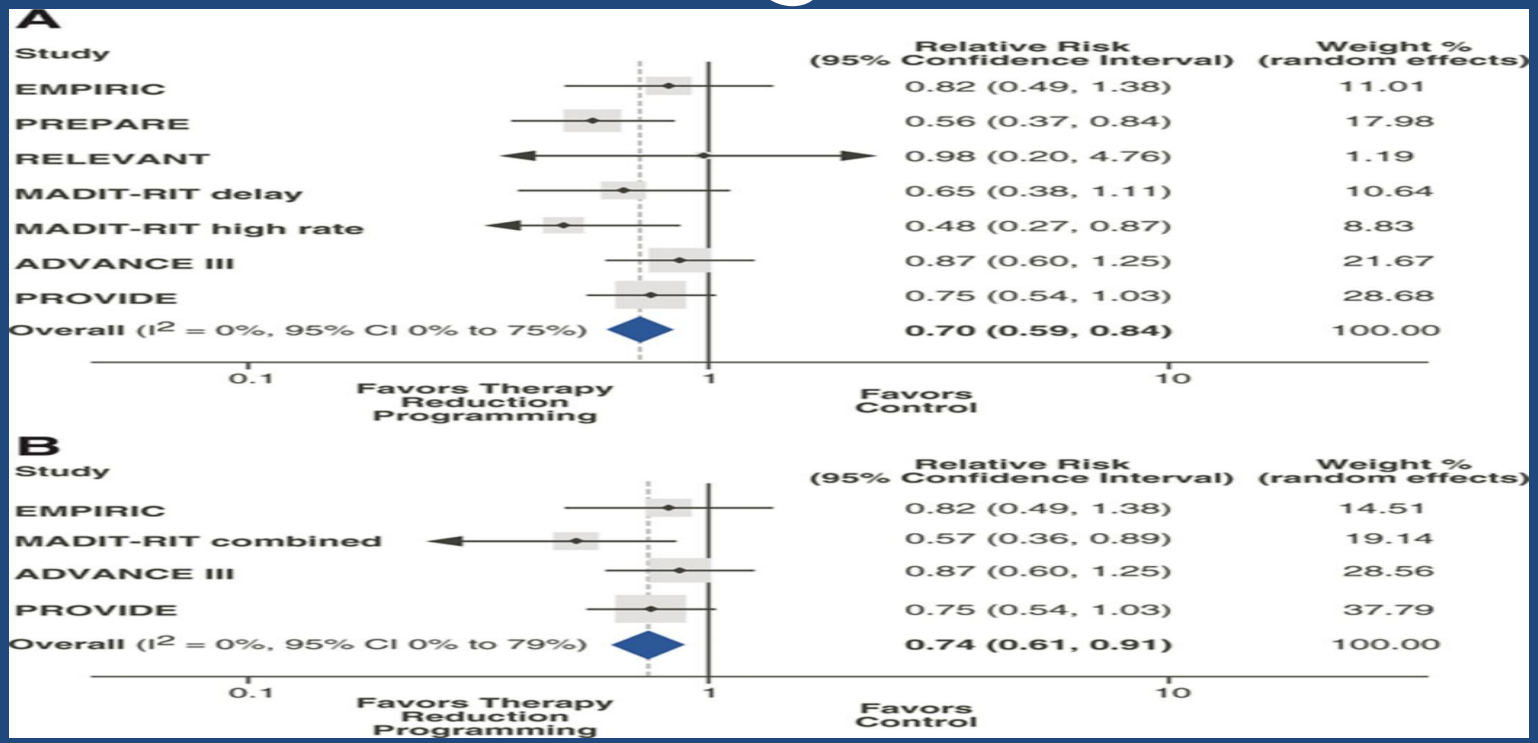
Observations:

Arrhythmia events

- Determine severity of arrhythmia vis-à-vis need for intervention

- Minimize ICD shocks

Minimizing ICD Shocks



Vern Hsen Tan et al. Circ Arrhythm Electrophysiol. 2014;7:164-170

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Minimizing ICD Shocks

Conventional programming	Therapy reduction programming*
VF detection: 1 sec	VF detection: 60 sec
VT detection: 2.5 secs 12 of 16	VT detection: 6 - 12 secs 30 of 40
SVT discrimination: 188-200	SVT discrimination: 188-230
ATP therapy: 188-200 bpm	ATP therapy 188-230 bpm

2015 HRS/EHRA/APHRS/SOLAECE expert consensus statement on optimal implantable cardioverter-defibrillator programming and testing

*for primary prevention

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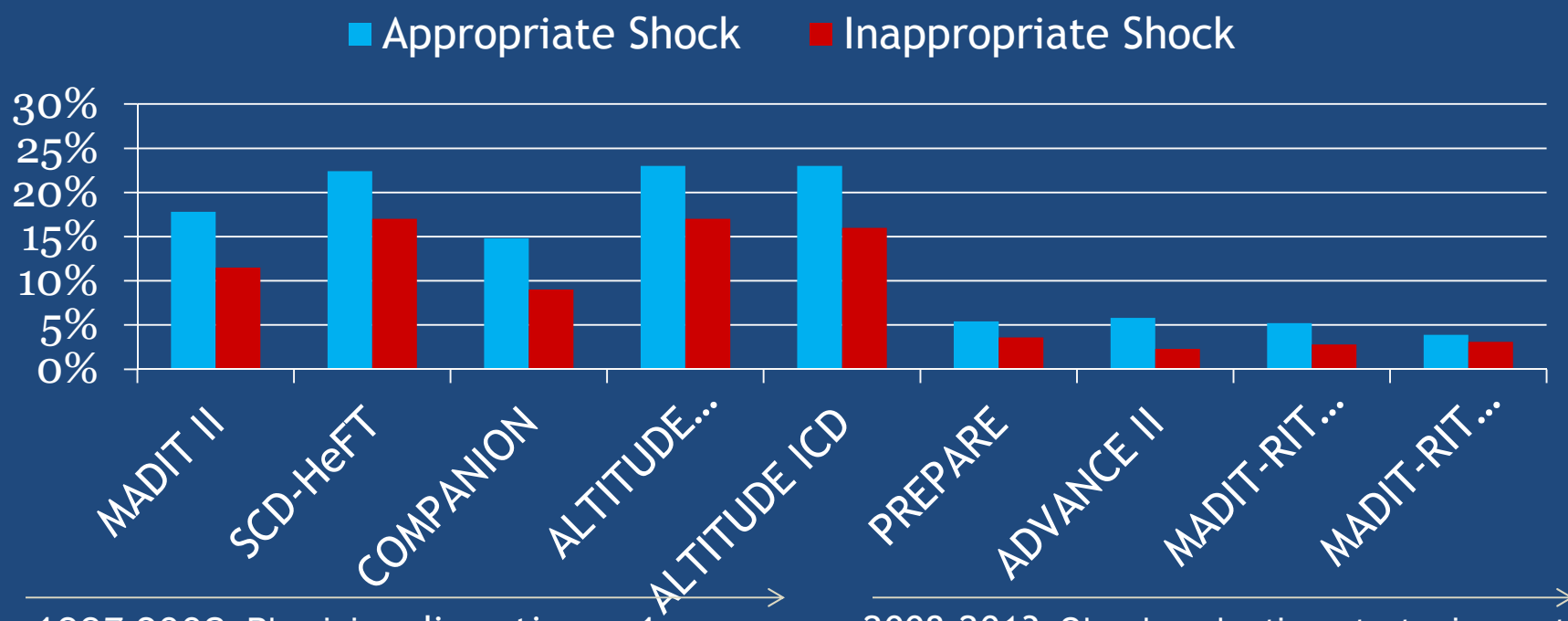
INCIDENCE Appropriate and Inappropriate Shocks



Daubert JP, et al. *JACC* 2008; 51:1357-1365.
Bardy GH,et al. SCD-HeFT. *NEJM* 2005; 352;3:225-237.
Saxon, LA et al. *Circulation* 2006; 114; 2766-2772.
Saxon LA et al. *Circulation* 2010; 122:2359-2367.

Wilkoff B, et al. *JACC* 2008; 52:541-550
Gasparini,M, et al. *JAMA* 2013; 309: 1903-1911.
Moss, A, et al. *NEJM* 2012; 367:2275-2283

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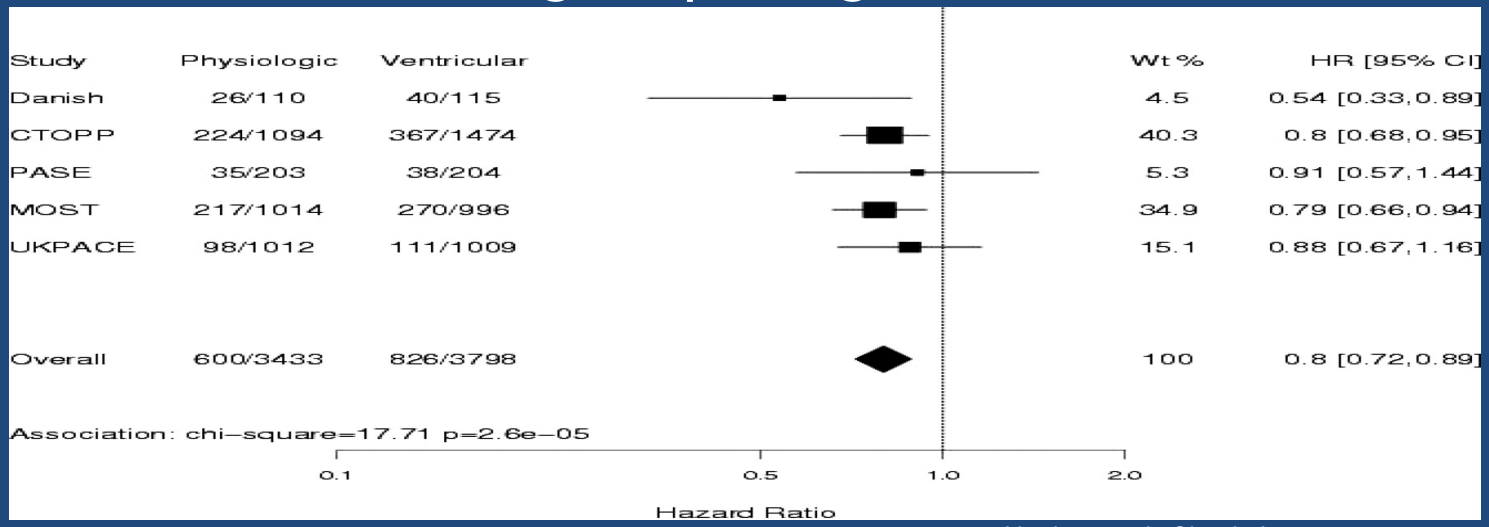
Assessing Clinical effectiveness

Observations: Percent paced

- Minimizing RV pacing



Effect of pacing mode on incidence of Afib

Healey, et al. *Circulation.* 2006;114:11-17.

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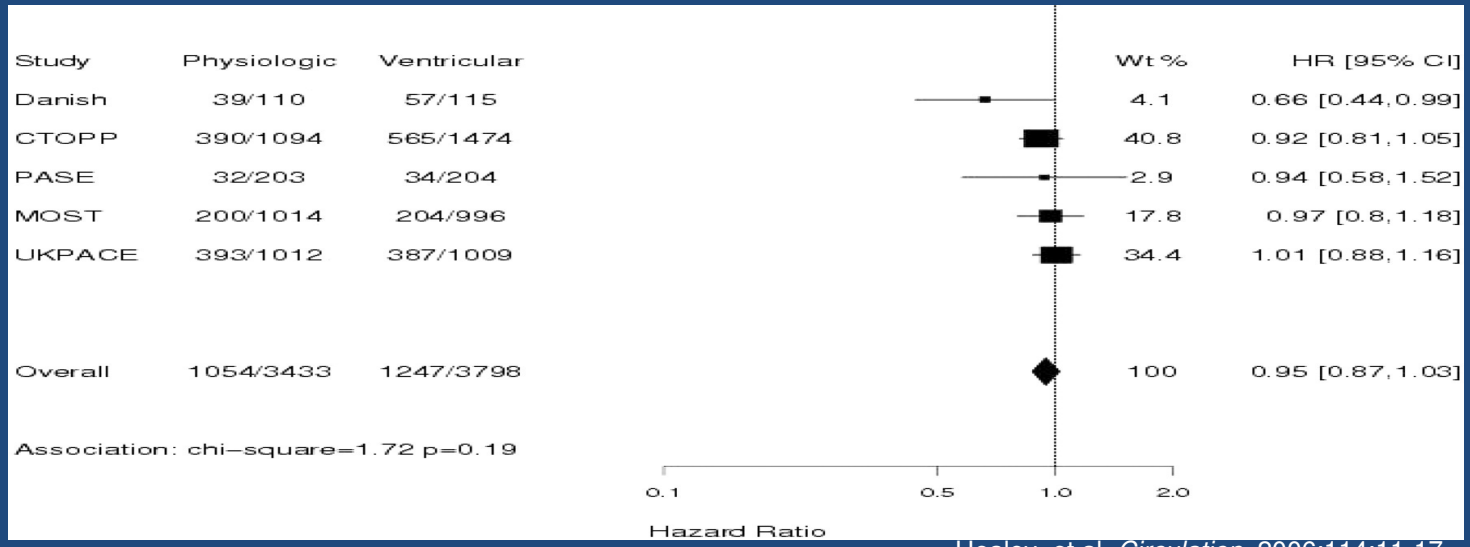
Assessing Clinical effectiveness

Observations: Percent paced

- Minimizing RV pacing



Healey, et al. *Circulation.* 2006;114:11-17.

Effect of pacing mode on incidence of stroke

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Assessing Clinical effectiveness

Observations:

Percent paced

- Minimizing RV pacing

Loss of conduction

Back-up V-pace

Courtesy of Medtronic Inc

Assessing Clinical effectiveness

Observations:

Percent paced

- Maximizing BiV pacing

Prior to Last Session 04-Feb-2016 to 05-May-2016 91 days		Since Last Session 05-May-2016 to 04-Aug-2016 91 days
AS-VS	0.3%	< 0.1%
AS-VP	5.8%	1.6%
AP-VS	1.8%	2.1%
AP-VP	92.2%	96.3%
Total VP*	89.3%	89.5%
VSR Pace	1.8%	1.9%
VS	8.9%	8.5%
CRT Pacing		
Bi-V	95.4%	94.8%
LV	0.0%	0.0%

* Total VP may decrease 1% to 2% due to periodic AdaptivCRT sensing.

2015 HRS/EHRA/APHRS/SOLAECE expert consensus statement on optimal implantable cardioverter-defibrillator programming and testing

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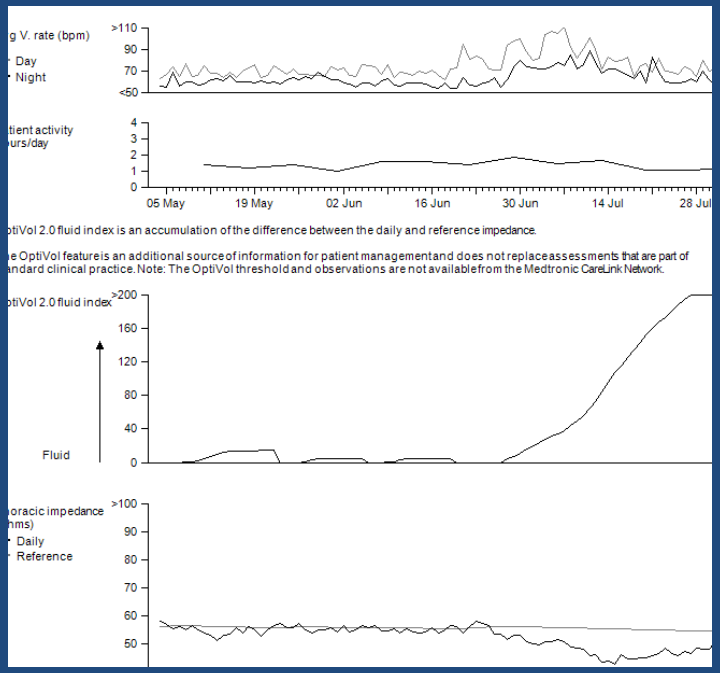
Assessing Clinical effectiveness

Observations:

- Lung impedance
- Ave v rate
- Fluid index



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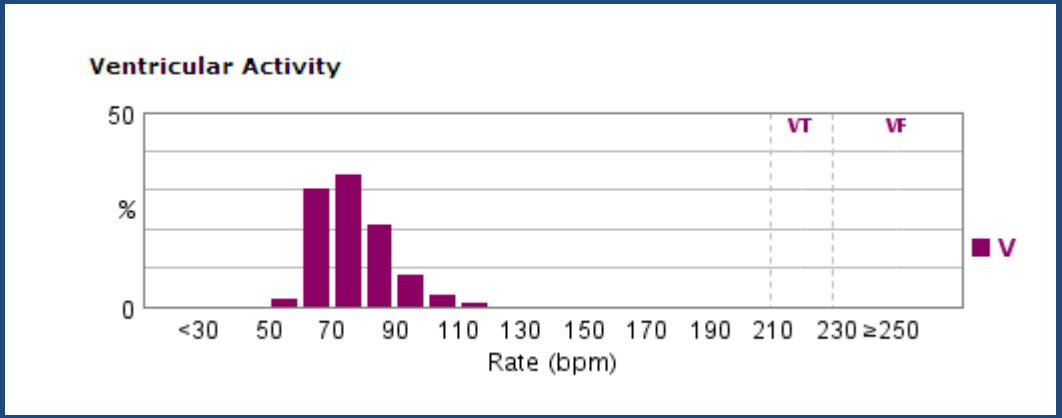
Assessing Clinical effectiveness

Observations:

- Histogram provides a quick look at median and range of HR



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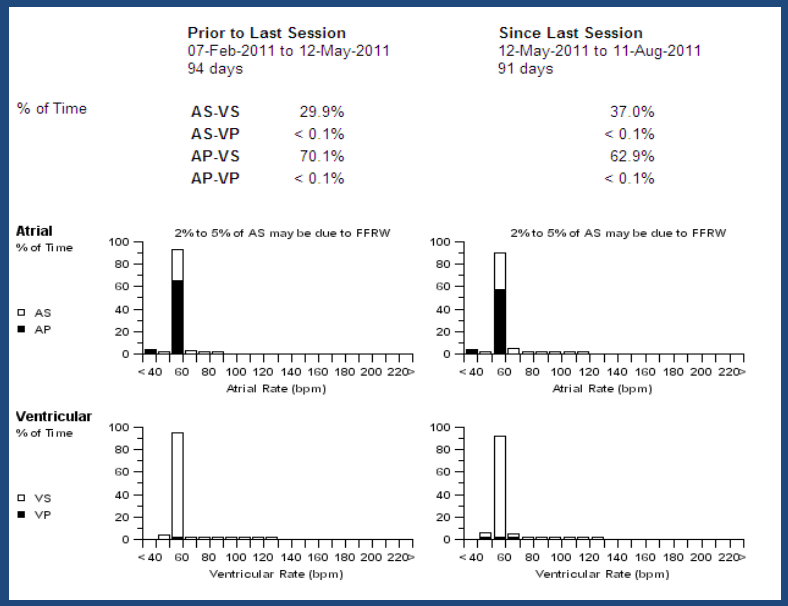
Assessing Clinical effectiveness

Observations: Need for rate response



Diagnose chronotropic incompetence

Correlate with activity level

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Assessing Clinical effectiveness

Voltage: battery status

Battery
Longevity: 5.3-8.7 yrs

Implant Date:	May 12, 2016
Voltage	3.01 V
Magnet Rate	100.0 ppm
Battery Current	12 uA
Remaining Capacity to ERI	>95%

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Assessing Clinical effectiveness

Evaluation (final):

Appropriate?

Normal function?

And let's not forget the patient

Pocket appearance

Good

Bad

Ugly

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And let's not forget the patient

Deactivating CIEDs in terminally ill patients

CRT non-responders

Life with a CIED

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Take away points

Device interrogation provides a myriad of data

A clinician's focus

- clinical effectiveness
- Impact on co-morbidities
- Qol issues


Thank you!

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