HEART FAILURE

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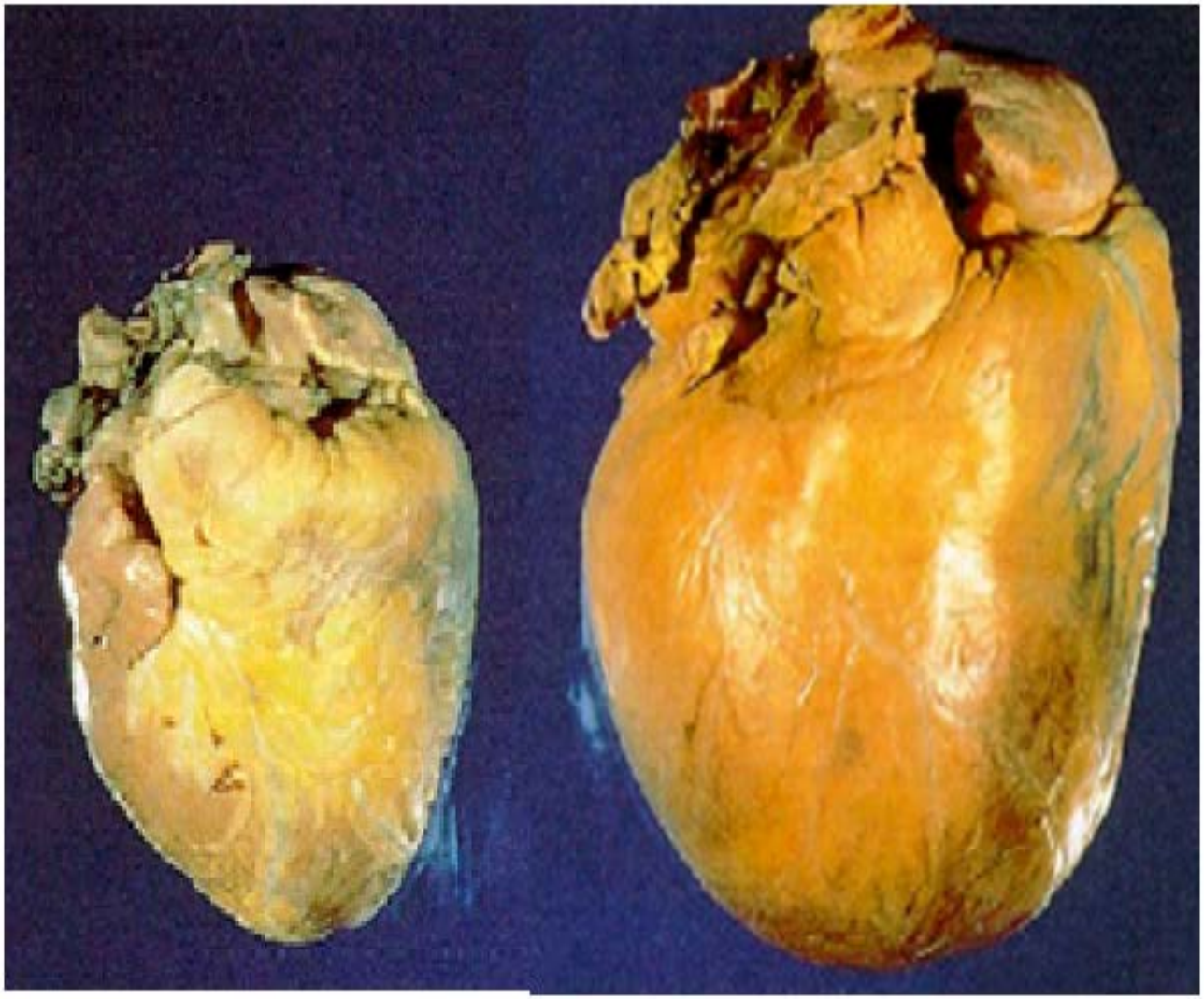
Congestive heart failure (CHF) is that condition in which the heart cannot generate *sufficient cardiac output* to meet the needs of the body while maintaining *low filling pressures*



HF is a complex clinical syndrome that results from any structural or functional impairment of ventricular filling or ejection of blood. The cardinal manifestations of HF are dyspnea and fatigue, which may limit exercise tolerance, and fluid retention, which may lead to pulmonary and/or splanchnic congestion and/or peripheral edema. Some patients have exercise intolerance but little evidence of fluid retention, whereas others complain primarily of edema, dyspnea, or fatigue. Because some patients present without signs or symptoms of volume overload, the term "heart failure" is preferred over "congestive heart failure." There is no single diagnostic test for HF because it is largely a clinical diagnosis based on a careful history and physical examination.

Circulation. 2013;128:e240-e327.

Framingham criteria for congestive heart failure

Major criteria
- Paroxysmal nocturnal dyspnea or orthopnea
- Neck-vein distention
- Rales
- Cardiomegaly
- Acute pulmonary edema
- S_3 gallop
- Increased venous pressure >16 cm of water
- Circulation time >25 sec
- Hepatojugular reflux

Minor criteria
- Ankle edema
- Night cough
- Dyspnea on exertion
- Hepatomegaly
- Pleural effusion
- Vital capacity decreased ⅓ from maximum
- Tachycardia (rate of >120/min)

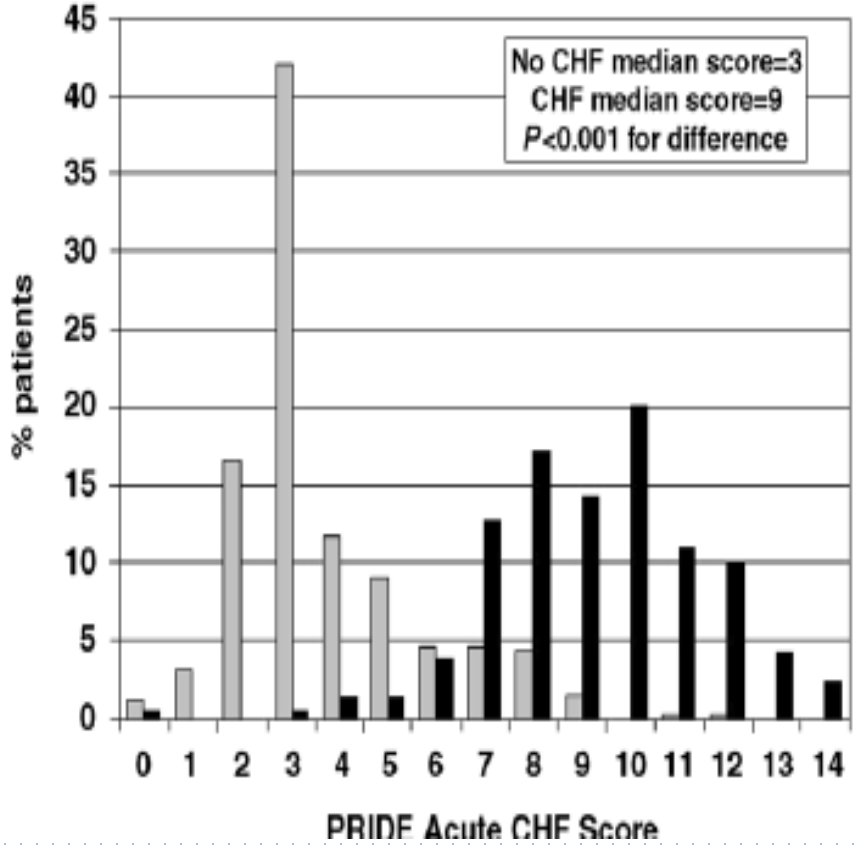
Major or minor criterion
- Weight loss >4.5 kg in 5 days in response to treatment

Boston criteria for congestive heart failure

Criterion	Point value[A]
Category I: History	
Rest dyspnea	4
Orthopnea	4
Paroxysmal nocturnal dyspnea	3
Dyspnea on walking on level	2
Dyspnea on climbing	1
Category II: Physical examination	
Heart rate abnormality (if 91–110 beats/min, 1 point; if >110 beats/min, 2 points)	1–2
Jugular-venous pressure elevation (if >6 cm H_2O, 2 points; if >6 cm H_2O plus hepatomegaly or edema, 3 points)	2–3
Lung crackles (if basilar, 1 point; if more than basilar, 2 points)	1–2
Wheezing	3
Third heart sound	3
Category III: Chest radiography	
Alveolar pulmonary edema	4
Interstitial pulmonary edema	3
Bilateral pleural effusions	3
Cardiothoracic ratio >0.50 (posteroanterior projection)	3
Upper zone flow redistribution	2

Predictor	Odds ratio	95% CI	β Coefficient	Integeric score
Elevated NT-proBNP*	44	21.0-91.0	3.8	4
Interstitial edema on chest x-ray	11	4.5-26.0	2.4	2
Orthopnea	9.6	4.0-23.0	2.26	2
Lack of fever	6.0	2.0-18.0	1.80	2
Current loop diuretic use	3.4	1.8-6.4	1.23	1
Age >75 y	2.7	1.4-5.2	1.0	1
Rales on lung exam	2.4	1.2-4.7	0.86	1
Lack of cough	2.3	1.2-4.3	0.81	1

A final possible score of 0 to 14 points was possible.
*Elevated NT-proBNP was defined as >450 pg/mL if age <50 years and >900 pg/mL if age ≥50 years as previously described.[7]

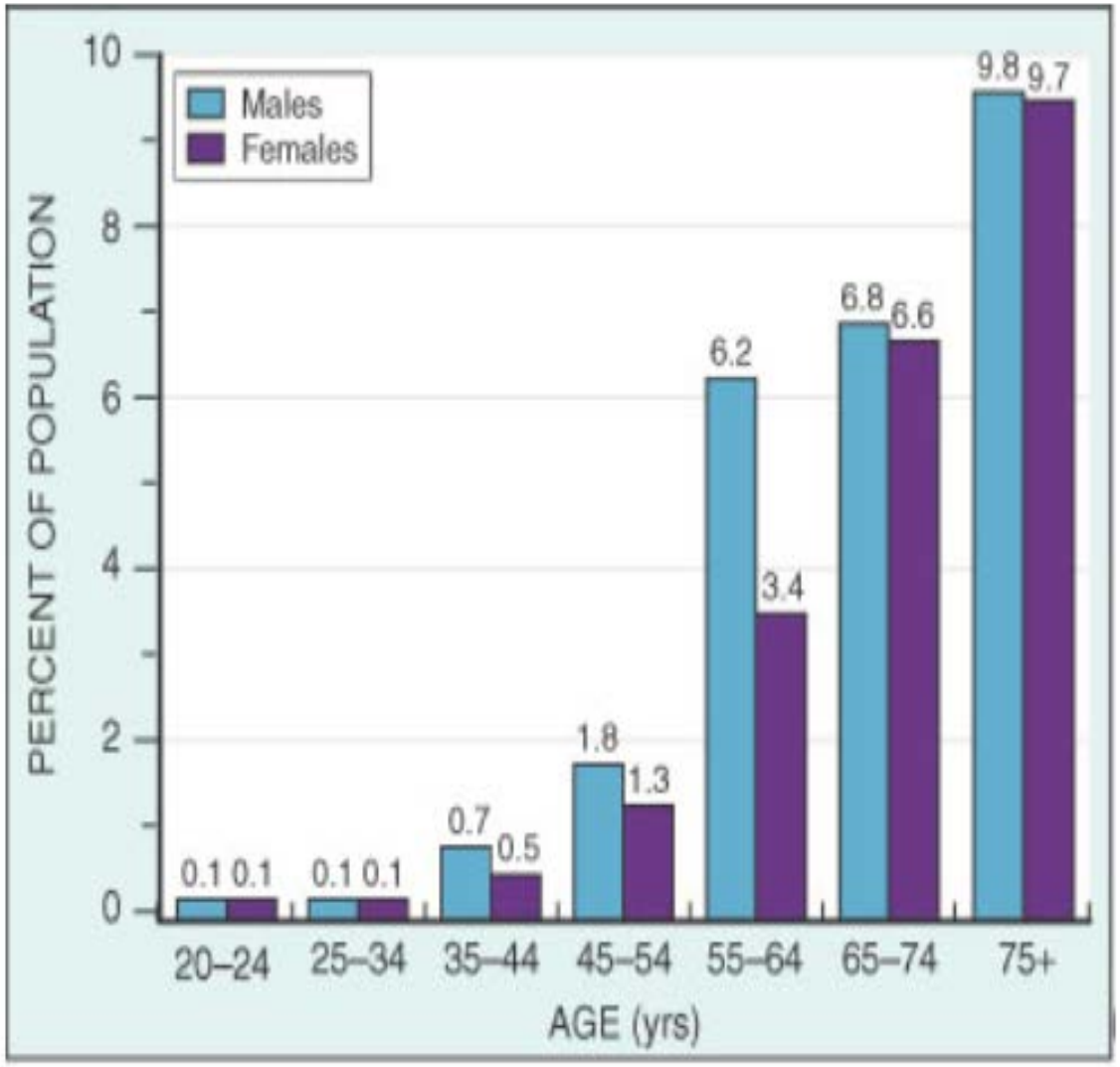


Am Heart J 2006;151:48-54.

HEART FAILURE

America's Silent Epidemic

HFSA

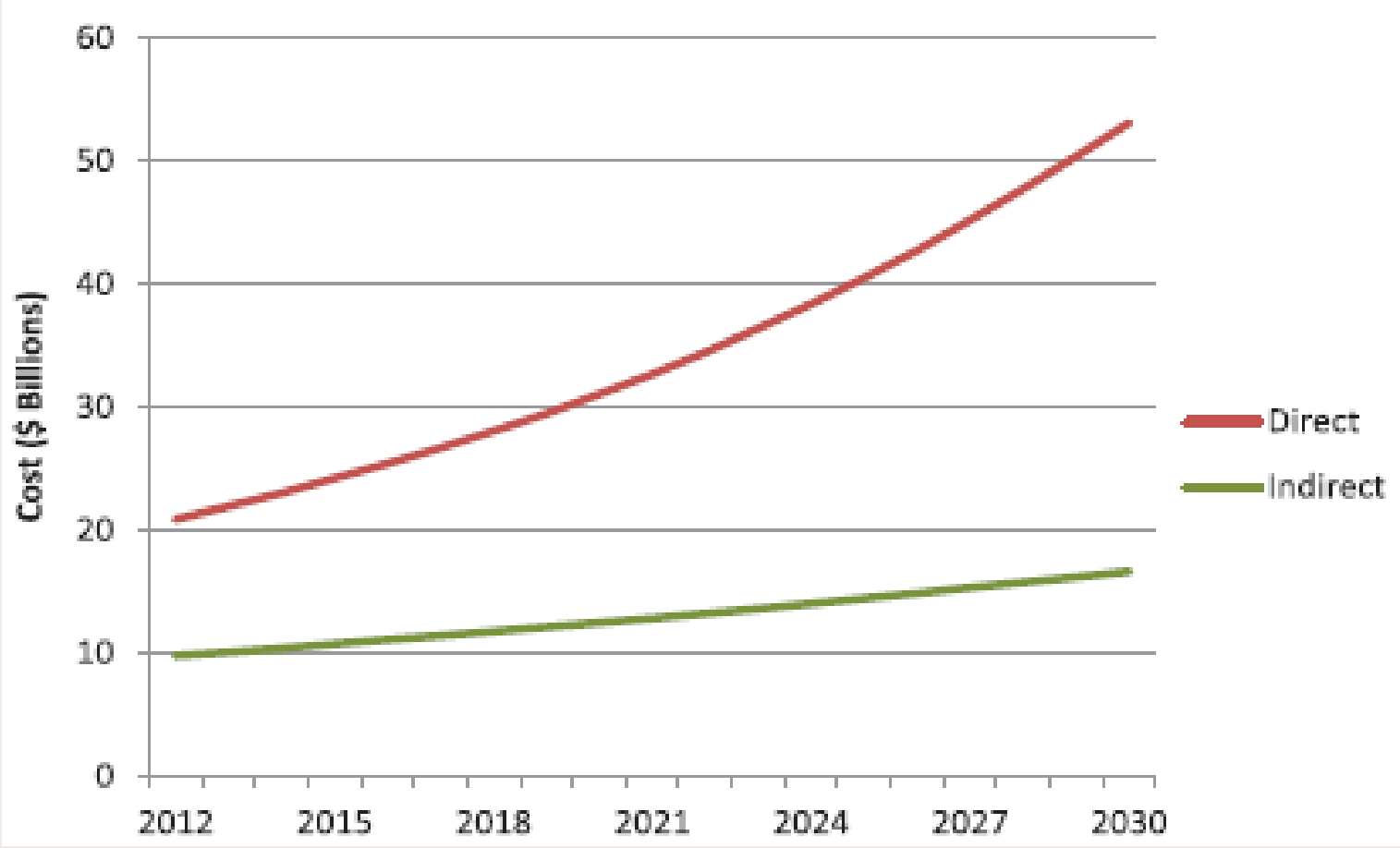


Braunwald's, Heart Disease, 8th edition

Table 1. Projections of the US Population With HF From 2010 to 2030 for Different Age Groups

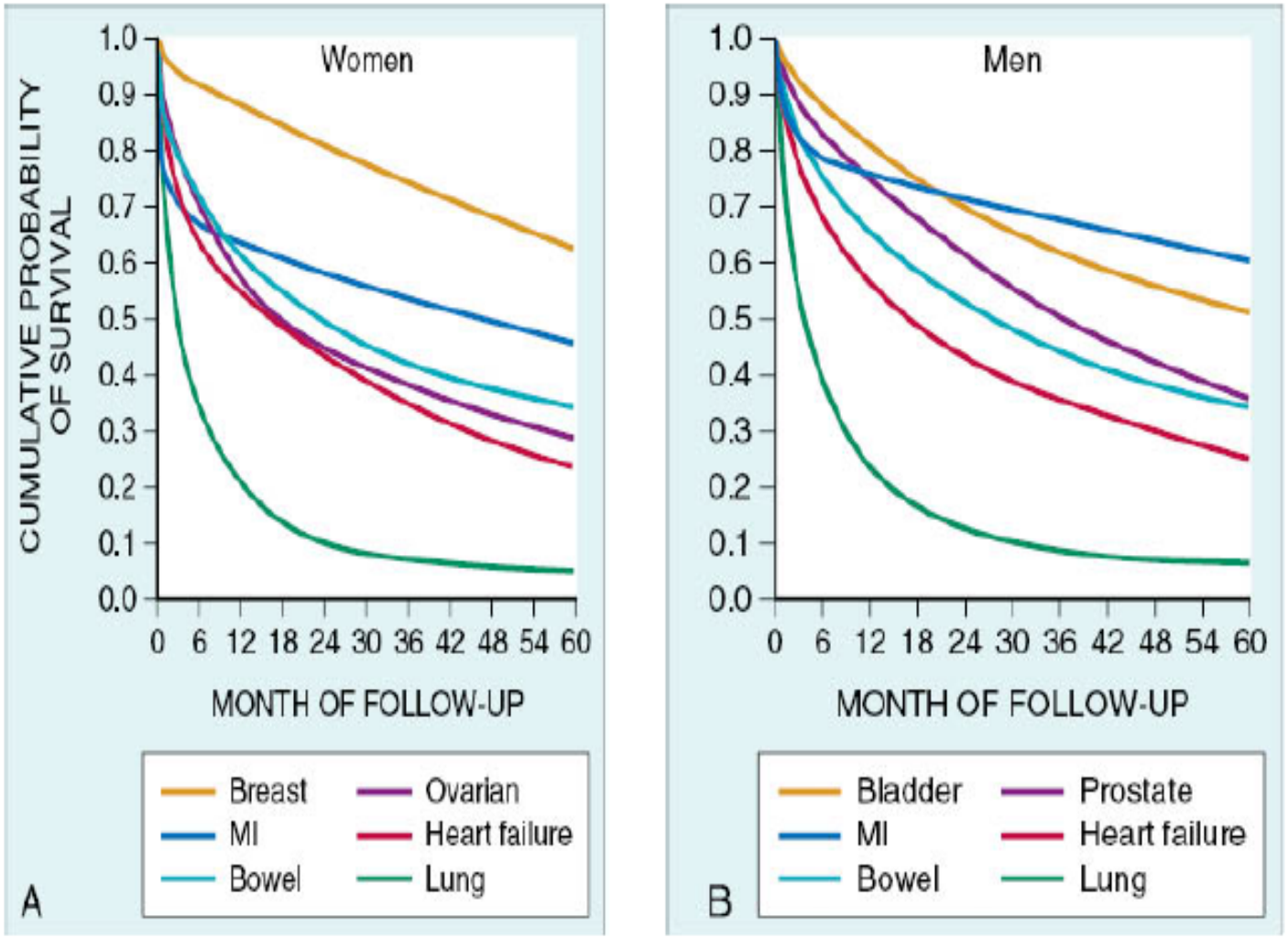
Year	All	18–44 y	45–64 y	65–79 y	≥80 y
2012	5 813 262	396 578	1 907 141	2 192 233	1 317 310
2015	6 190 606	402 926	1 949 669	2 483 853	1 354 158
2020	6 859 623	417 600	1 974 585	3 004 002	1 463 436
2025	7 644 674	434 635	1 969 852	3 526 347	1 713 840
2030	8 489 428	450 275	2 000 896	3 857 729	2 180 528

Circ Heart Fail. 2013;6:606-619

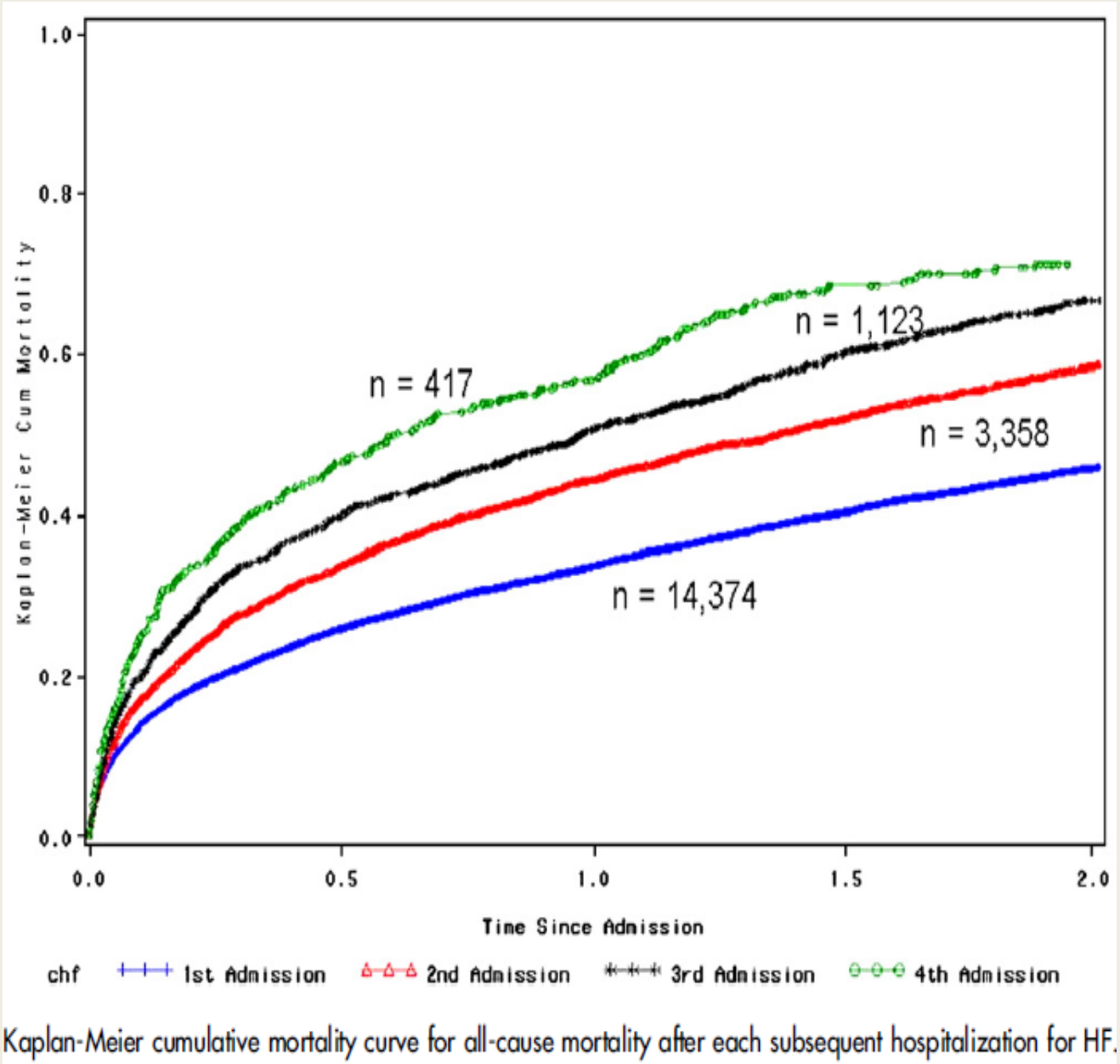


Circ Heart Fail. 2013;6:606-619

Survival Following a 1st Admission For Heart Failure, (MI and 4 Most Common Cancers)

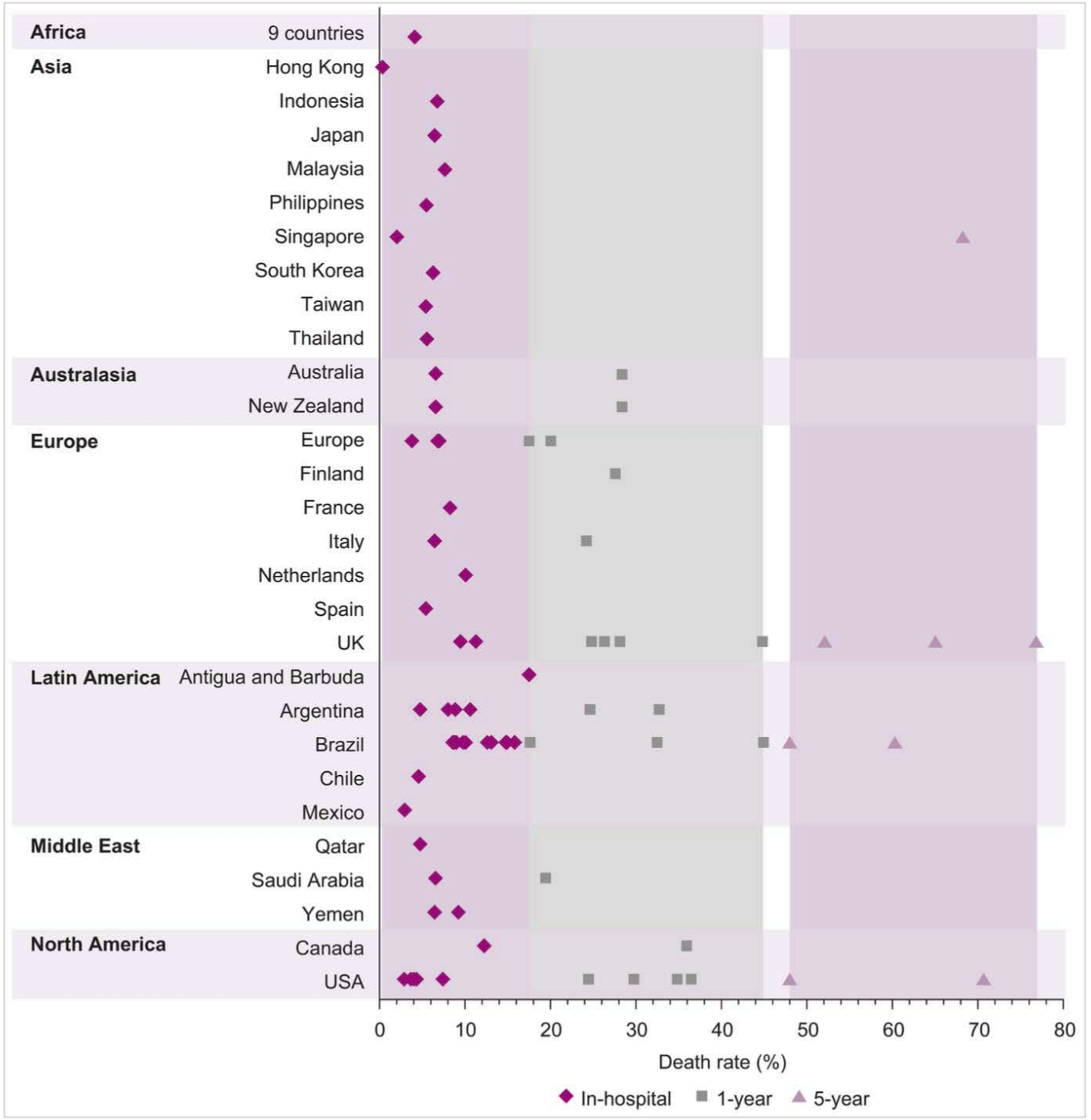


Stewart et al, Eur Heart J 2001;3:315.



Kaplan-Meier cumulative mortality curve for all-cause mortality after each subsequent hospitalization for HF.

Am Heart J 2007;154:260-6


Africa
9 countries
Asia
Hong Kong
Indonesia
Japan
Malaysia
Philippines
Singapore
South Korea
Taiwan
Thailand
Australasia
Australia
New Zealand
Europe
Europe
Finland
France
Italy
Netherlands
Spain
UK
Latin America
Antigua and Barbuda
Argentina
Brazil
Chile
Mexico
Middle East
Qatar
Saudi Arabia
Yemen
North America
Canada
USA
0
10
20
30
40
50
60
70
80
Death rate (%)
In-hospital
1-year
5-year

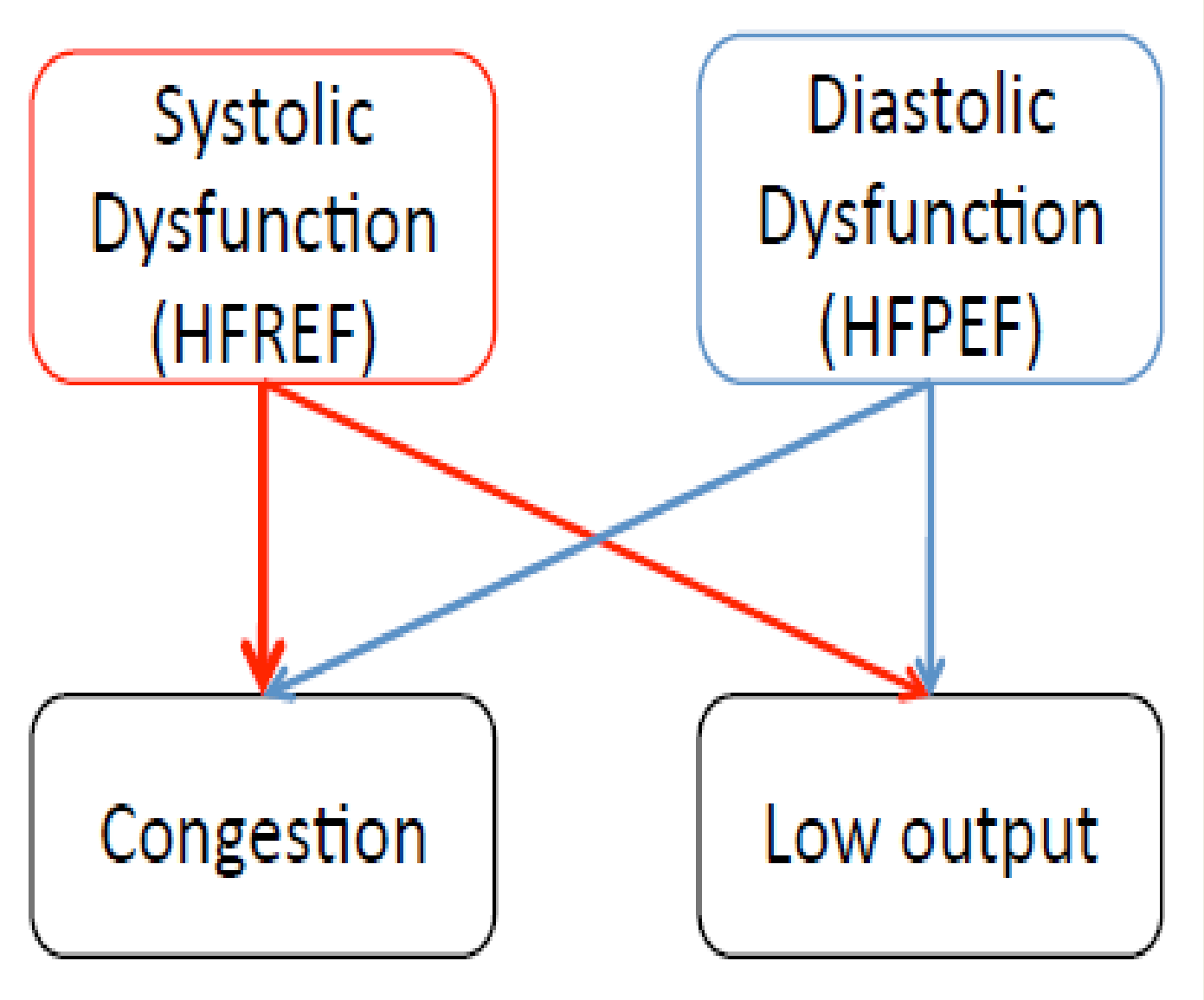
Cause of Death	Incidence	Deaths
Heart failure[3]	≈500 000	284 365
Lung cancer[4]	196 252	158 006
Breast cancer[4]	188 587	41 316
Prostate cancer[4]	189 075	29 002
HIV/AIDS[5]	37 726	16 395

Only about 30 million is committed in research dollars for heart failure annually.

In comparison lung cancer research receives $132 million annually.*

*: HFSA.org

EDUCATION


Systolic Dysfunction (HFREF)
Diastolic Dysfunction (HFPEF)
Congestion
Low output

ACCF/AHA Practice Guideline

2013 ACCF/AHA Guideline for the Management of Heart Failure

A Report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines

Developed in Collaboration With the American College of Chest Physicians, Heart Rhythm Society and International Society for Heart and Lung Transplantation

Endorsed by the American Association of Cardiovascular and Pulmonary Rehabilitation

2017 ACC/AHA/HFSA Focused Update of the 2013 ACCF/AHA Guideline for the Management of Heart Failure

A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines and the Heart Failure Society of America

Developed in Collaboration With the American Academy of Family Physicians, American College of Chest Physicians, and International Society for Heart and Lung Transplantation

Classification	EF (%)	Description
I. Heart failure with reduced ejection fraction (HF*r*EF)	≤40	Also referred to as systolic HF. Randomized controlled trials have mainly enrolled patients with HF*r*EF, and it is only in these patients that efficacious therapies have been demonstrated to date.
II. Heart failure with preserved ejection fraction (HF*p*EF)	≥50	Also referred to as diastolic HF. Several different criteria have been used to further define HF*p*EF. The diagnosis of HF*p*EF is challenging because it is largely one of excluding other potential noncardiac causes of symptoms suggestive of HF. To date, efficacious therapies have not been identified.
a. HF*p*EF, borderline	41 to 49	These patients fall into a borderline or intermediate group. Their characteristics, treatment patterns, and outcomes appear similar to those of patients with HF*p*EF.
b. HF*p*EF, improved	>40	It has been recognized that a subset of patients with HF*p*EF previously had HF*r*EF. These patients with improvement or recovery in EF may be clinically distinct from those with persistently preserved or reduced EF. Further research is needed to better characterize these patients.

Circulation. 2013;128:e240-e327.

Relationship between clinical classification and left ventricular ejection fraction

	Study					
	Framingham		Duke		Boston	
	+	−	+	−	+	−
n	191	216	228	179	132	275
LVEF category [%(n)]						
≤40	50 (96)	26 (57)	49 (112)	23 (41)	58 (76)	28 (77)
41–49	10 (19)	14 (31)	14 (31)	11 (19)	8 (11)	14 (39)
≥50	40 (76)	59 (128)	38 (85)	66 (119)	34 (45)	58 (159)
Sensitivity[A]	0.63		0.73		0.50	
Specificity[A]	0.63		0.54		0.78	

+ = CHF present by criteria; − = CHF absent by criteria.

Circulation 77, No. 3, 607–612, 1988.

HFpEF

- Aortic Stenosis and Regurgitation
- Mitral Stenosis and Regurgitation
- Tricuspid Regurgitation
- Obstructive Sleep Apnea
- Pulmonary Arterial Hypertension
- Cardiac Amyloidosis
- Cardiac Sarcoidosis
- Constrictive Pericarditis
- Hypertensive Cardiomyopathy
- Hypertrophic Cardiomyopathy

ACCF/AHA Stages of HF[38]		NYHA Functional Classification[46]	
A	At high risk for HF but without structural heart disease or symptoms of HF	None	
B	Structural heart disease but without signs or symptoms of HF	I	No limitation of physical activity. Ordinary physical activity does not cause symptoms of HF.
C	Structural heart disease with prior or current symptoms of HF	I	No limitation of physical activity. Ordinary physical activity does not cause symptoms of HF.
		II	Slight limitation of physical activity. Comfortable at rest, but ordinary physical activity results in symptoms of HF.
		III	Marked limitation of physical activity. Comfortable at rest, but less than ordinary activity causes symptoms of HF.
		IV	Unable to carry on any physical activity without symptoms of HF, or symptoms of HF at rest.
D	Refractory HF requiring specialized interventions	IV	Unable to carry on any physical activity without symptoms of HF, or symptoms of HF at rest.

Table 25. INTERMACS Profiles

Profile*	Profile Description	Features
1	Critical cardiogenic shock ("Crash and burn")	Life-threatening hypotension and rapidly escalating inotropic/pressor support, with critical organ hypoperfusion often confirmed by worsening acidosis and lactate levels.
2	Progressive decline ("Sliding fast" on inotropes)	"Dependent" on inotropic support but nonetheless shows signs of continuing deterioration in nutrition, renal function, fluid retention, or other major status indicator. Can also apply to a patient with refractory volume overload, perhaps with evidence of impaired perfusion, in whom inotropic infusions *cannot be maintained* due to tachyarrhythmias, clinical ischemia, or other intolerance.
3	Stable but inotrope dependent	Clinically stable on mild-moderate doses of intravenous inotropes (or has a temporary circulatory support device) after repeated documentation of failure to wean without symptomatic hypotension, worsening symptoms, or progressive organ dysfunction (usually renal).
4	Resting symptoms on oral therapy at home	Patient who is at home on oral therapy but frequently has symptoms of congestion at rest or with activities of daily living (dressing or bathing). He or she may have orthopnea, shortness of breath during dressing or bathing, gastrointestinal symptoms (abdominal discomfort, nausea, poor appetite), disabling ascites, or severe lower-extremity edema.
5	Exertion intolerant ("housebound")	Patient who is comfortable at rest but unable to engage in any activity, living predominantly within the house or housebound.
6	Exertion limited ("walking wounded")	Patient who is comfortable at rest without evidence of fluid overload but who is able to do some mild activity. Activities of daily living are comfortable and minor activities outside the home such as visiting friends or going to a restaurant can be performed, but fatigue results within a few minutes or with any meaningful physical exertion.
7	Advanced NYHA class III	Patient who is clinically stable with a reasonable level of comfortable activity, despite a history of previous decompensation that is not recent. This patient is usually able to walk more than a block. Any decompensation requiring intravenous diuretics or hospitalization within the previous month should make this person a Patient Profile 6 or lower.

CLASS (STRENGTH) OF RECOMMENDATION

CLASS I (STRONG) — **Benefit >>> Risk**

Suggested phrases for writing recommendations:
- Is recommended
- Is indicated/useful/effective/beneficial
- Should be performed/administered/other
- Comparative-Effectiveness Phrases†:
  - Treatment/strategy A is recommended/indicated in preference to treatment B
  - Treatment A should be chosen over treatment B

CLASS IIa (MODERATE) — **Benefit >> Risk**

Suggested phrases for writing recommendations:
- Is reasonable
- Can be useful/effective/beneficial
- Comparative-Effectiveness Phrases†:
  - Treatment/strategy A is probably recommended/indicated in preference to treatment B
  - It is reasonable to choose treatment A over treatment B

CLASS IIb (WEAK) — **Benefit ≥ Risk**

Suggested phrases for writing recommendations:
- May/might be reasonable
- May/might be considered
- Usefulness/effectiveness is unknown/unclear/uncertain or not well established

CLASS III: No Benefit (MODERATE) — **Benefit = Risk**
(Generally, LOE A or B use only)

Suggested phrases for writing recommendations:
- Is not recommended
- Is not indicated/useful/effective/beneficial
- Should not be performed/administered/other

CLASS III: Harm (STRONG) — **Risk > Benefit**

Suggested phrases for writing recommendations:
- Potentially harmful
- Causes harm
- Associated with excess morbidity/mortality
- Should not be performed/administered/other

LEVEL (QUALITY) OF EVIDENCE‡

LEVEL A
- High-quality evidence‡ from more than 1 RCT
- Meta-analyses of high-quality RCTs
- One or more RCTs corroborated by high-quality registry studies

LEVEL B-R (Randomized)
- Moderate-quality evidence‡ from 1 or more RCTs
- Meta-analyses of moderate-quality RCTs

LEVEL B-NR (Nonrandomized)
- Moderate-quality evidence‡ from 1 or more well-designed, well-executed nonrandomized studies, observational studies, or registry studies
- Meta-analyses of such studies

LEVEL C-LD (Limited Data)
- Randomized or nonrandomized observational or registry studies with limitations of design or execution
- Meta-analyses of such studies
- Physiological or mechanistic studies in human subjects

LEVEL C-EO (Expert Opinion)

Consensus of expert opinion based on clinical experience

COR and LOE are determined independently (any COR may be paired with any LOE).

A recommendation with LOE C does not imply that the recommendation is weak. Many important clinical questions addressed in guidelines do not lend themselves to clinical trials. Although RCTs are unavailable, there may be a very clear clinical consensus that a particular test or therapy is useful or effective.

* The outcome or result of the intervention should be specified (an improved clinical outcome or increased diagnostic accuracy or incremental prognostic information).

† For comparative-effectiveness recommendations (COR I and IIa; LOE A and B only), studies that support the use of comparator verbs should involve direct comparisons of the treatments or strategies being evaluated.

‡ The method of assessing quality is evolving, including the application of standardized, widely used, and preferably validated evidence grading tools; and for systematic reviews, the incorporation of an Evidence Review Committee.

COR indicates Class of Recommendation; EO, expert opinion; LD, limited data; LOE, Level of Evidence; NR, nonrandomized; R, randomized; and RCT, randomized controlled trial.

Table 10. Recommendations for Noninvasive Cardiac Imaging

Recommendations	COR	LOE
Patients with suspected, acute, or new-onset HF should undergo a chest x-ray	I	C
A 2-dimensional echocardiogram with Doppler should be performed for initial evaluation of HF	I	C
Repeat measurement of EF is useful in patients with HF who have had a significant change in clinical status or received treatment that might affect cardiac function or for consideration of device therapy	I	C
Noninvasive imaging to detect myocardial ischemia and viability is reasonable in HF and CAD	IIa	C
Viability assessment is reasonable before revascularization in HF patients with CAD	IIa	B[281–285]
Radionuclide ventriculography or MRI can be useful to assess LVEF and volume	IIa	C
MRI is reasonable when assessing myocardial infiltration or scar	IIa	B[286–288]
Routine repeat measurement of LV function assessment should not be performed	III: No Benefit	B[289,290]

Table 11. Recommendations for Invasive Evaluation

Recommendations	COR	LOE
Monitoring with a pulmonary artery catheter should be performed in patients with respiratory distress or impaired systemic perfusion when clinical assessment is inadequate	I	C
Invasive hemodynamic monitoring can be useful for carefully selected patients with acute HF with persistent symptoms and/or when hemodynamics are uncertain	IIa	C
When ischemia may be contributing to HF, coronary arteriography is reasonable	IIa	C
Endomyocardial biopsy can be useful in patients with HF when a specific diagnosis is suspected that would influence therapy	IIa	C
Routine use of invasive hemodynamic monitoring is not recommended in normotensive patients with acute HF	III: No Benefit	B[305]
Endomyocardial biopsy should not be performed in the routine evaluation of HF	III: Harm	C

Figure 1. Biomarkers Indications for Use

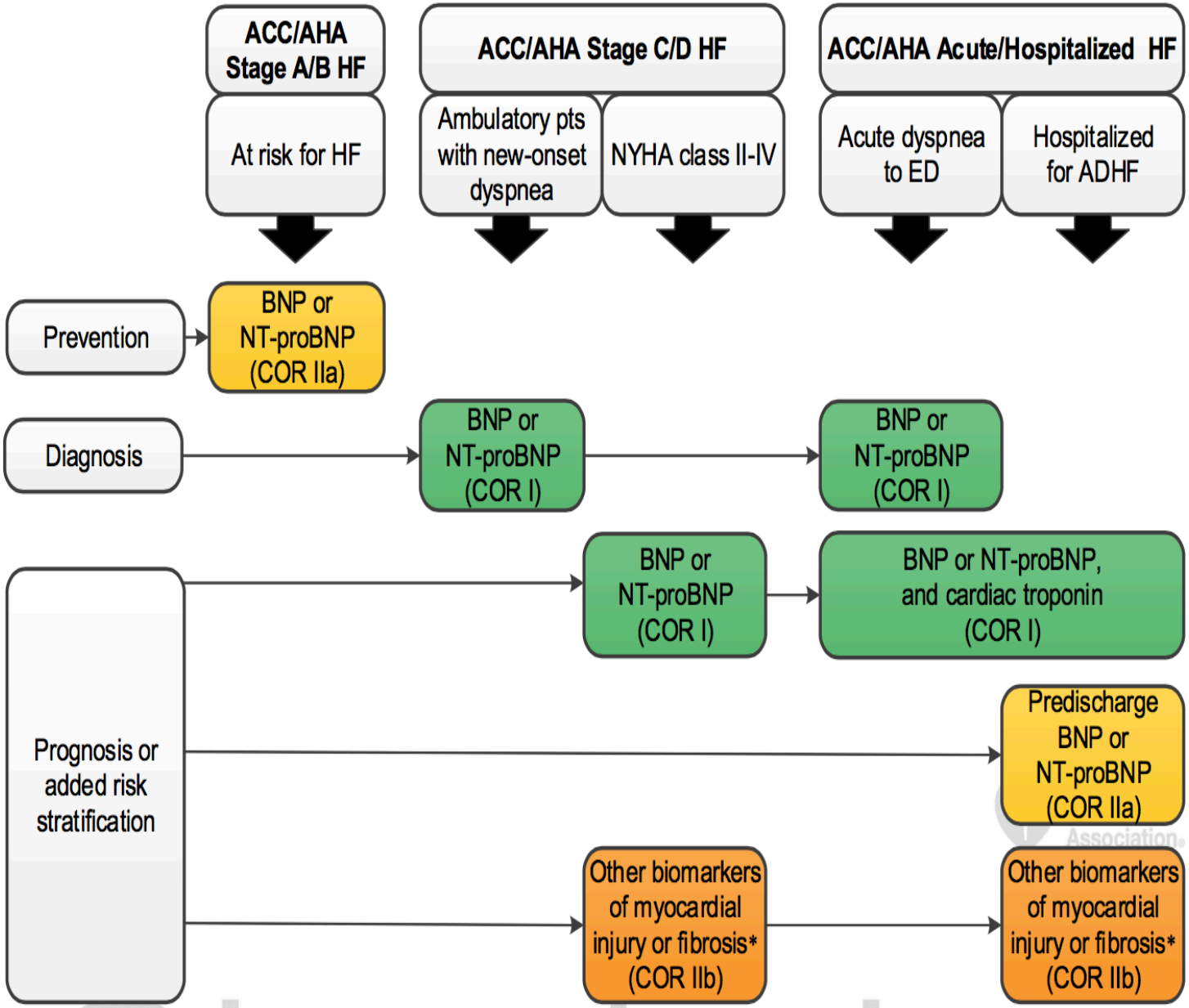


Table 12. Recommendations for Treatment of Stage B HF

Recommendations	COR	LOE
In patients with a history of MI and reduced EF, ACE inhibitors or ARBs should be used to prevent HF	I	A
In patients with MI and reduced EF, evidence-based beta blockers should be used to prevent HF	I	B
In patients with MI, statins should be used to prevent HF	I	A
Blood pressure should be controlled to prevent symptomatic HF	I	A
ACE inhibitors should be used in all patients with a reduced EF to prevent HF	I	A
Beta blockers should be used in all patients with a reduced EF to prevent HF	I	C
An ICD is reasonable in patients with asymptomatic ischemic cardiomyopathy who are at least 40 d post-MI, have an LVEF ≤30%, and on GDMT	IIa	B
Nondihydropyridine calcium channel blockers may be harmful in patients with low LVEF	III: Harm	C

Table 19. Recommendations for Pharmacological Therapy for Management of Stage C HF*r*EF

Recommendations	COR	LOE
Diuretics		
Diuretics are recommended in patients with HF*r*EF with fluid retention	I	C
ACE inhibitors		
ACE inhibitors are recommended for all patients with HF*r*EF	I	A
ARBs		
ARBs are recommended in patients with HF*r*EF who are ACE inhibitor intolerant	I	A
ARBs are reasonable as alternatives to ACE inhibitors as first-line therapy in HF*r*EF	IIa	A
Addition of an ARB may be considered in persistently symptomatic patients with HF*r*EF on GDMT	IIb	A
Routine *combined* use of an ACE inhibitor, ARB, and aldosterone antagonist is potentially harmful	III: Harm	C
Beta blockers		
Use of 1 of the 3 beta blockers proven to reduce mortality is recommended for all stable patients	I	A
Aldosterone receptor antagonists		
Aldosterone receptor antagonists are recommended in patients with NYHA class II–IV who have LVEF ≤35%	I	A
Aldosterone receptor antagonists are recommended in patients following an acute MI who have LVEF ≤40% with symptoms of HF or DM	I	B
Inappropriate use of aldosterone receptor antagonists may be harmful	III: Harm	B
Hydralazine and isosorbide dinitrate		
The combination of hydralazine and isosorbide dinitrate is recommended for African Americans with NYHA class III–IV HF*r*EF on GDMT	I	A
A combination of hydralazine and isosorbide dinitrate can be useful in patients with HF*r*EF who cannot be given ACE inhibitors or ARBs	IIa	B
Digoxin		
Digoxin can be beneficial in patients with HF*r*EF	IIa	B
Anticoagulation		
Patients with chronic HF with permanent/persistent/paroxysmal AF and an additional risk factor for cardioembolic stroke should receive chronic anticoagulant therapy*	I	A
The selection of an anticoagulant agent should be individualized	I	C
Chronic anticoagulation is reasonable for patients with chronic HF who have permanent/persistent/paroxysmal AF but are without an additional risk factor for cardioembolic stroke*	IIa	B
Anticoagulation is not recommended in patients with chronic HF*r*EF without AF, a prior thromboembolic event, or a cardioembolic source	III: No Benefit	B
Statins		
Statins are not beneficial as adjunctive therapy when prescribed solely for HF	III: No Benefit	A
Omega-3 fatty acids		
Omega-3 PUFA supplementation is reasonable to use as adjunctive therapy in HF*r*EF or HF*p*EF patients	IIa	B
Other drugs		
Nutritional supplements as treatment for HF are not recommended in HF*r*EF	III: No Benefit	B
Hormonal therapies other than to correct deficiencies are not recommended in HF*r*EF	III: No Benefit	C
Drugs known to adversely affect the clinical status of patients with HF*r*EF are potentially harmful and should be avoided or withdrawn	III: Harm	B
Long-term use of an infusion of a positive inotropic drug is not recommended and may be harmful except as palliation	III: Harm	C
Calcium channel blockers		
Calcium channel–blocking drugs are not recommended as routine treatment in HF*r*EF	III: No Benefit	A

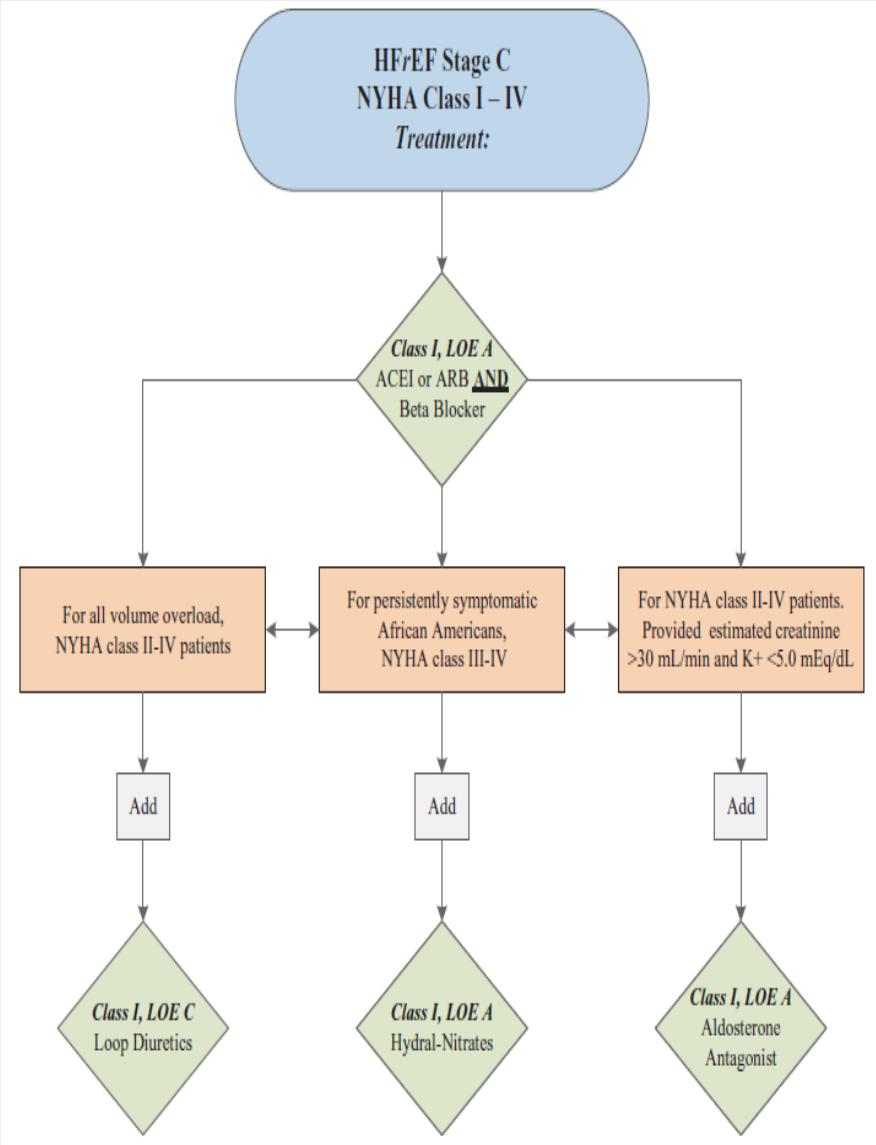

HFrEF Stage C
NYHA Class I – IV
Treatment:
Class I, LOE A
ACEI or ARB AND
Beta Blocker
For all volume overload, NYHA class II-IV patients
For persistently symptomatic African Americans, NYHA class III-IV
For NYHA class II-IV patients. Provided estimated creatinine >30 mL/min and K+ <5.0 mEq/dL
Add
Add
Add
Class I, LOE C
Loop Diuretics
Class I, LOE A
Hydral-Nitrates
Class I, LOE A
Aldosterone Antagonist

Table 18. Medical Therapy for Stage C HF*r*EF: Magnitude of Benefit Demonstrated in RCTs

GDMT	RR Reduction in Mortality (%)	NNT for Mortality Reduction (Standardized to 36 mo)	RR Reduction in HF Hospitalizations (%)
ACE inhibitor or ARB	17	26	31
Beta blocker	34	9	41
Aldosterone antagonist	30	6	35
Hydralazine/nitrate	43	7	33

The NEW ENGLAND JOURNAL of MEDICINE

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Angiotensin–Neprilysin Inhibition versus Enalapril in Heart Failure

John J.V. McMurray, M.D., Milton Packer, M.D., Akshay S. Desai, M.D., M.P.H., Jianjian Gong, Ph.D., Martin P. Lefkowitz, M.D., Adel R. Rizkala, Pharm.D., Jean L. Rouleau, M.D., Victor C. Shi, M.D., Scott D. Solomon, M.D., Karl Swedberg, M.D., Ph.D., and Michael R. Zile, M.D., for the PARADIGM-HF Investigators and Committees*

METHODS

In this double-blind trial, we randomly assigned 8442 patients with class II, III, or IV heart failure and an ejection fraction of 40% or less to receive either LCZ696 (at a dose of 200 mg twice daily) or enalapril (at a dose of 10 mg twice daily), in addition to recommended therapy. The primary outcome was a composite of death from cardiovascular causes or hospitalization for heart failure, but the trial was designed to detect a difference in the rates of death from cardiovascular causes.

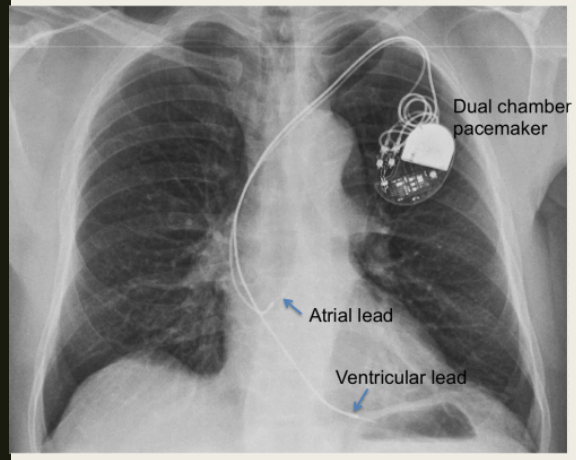
CONCLUSIONS

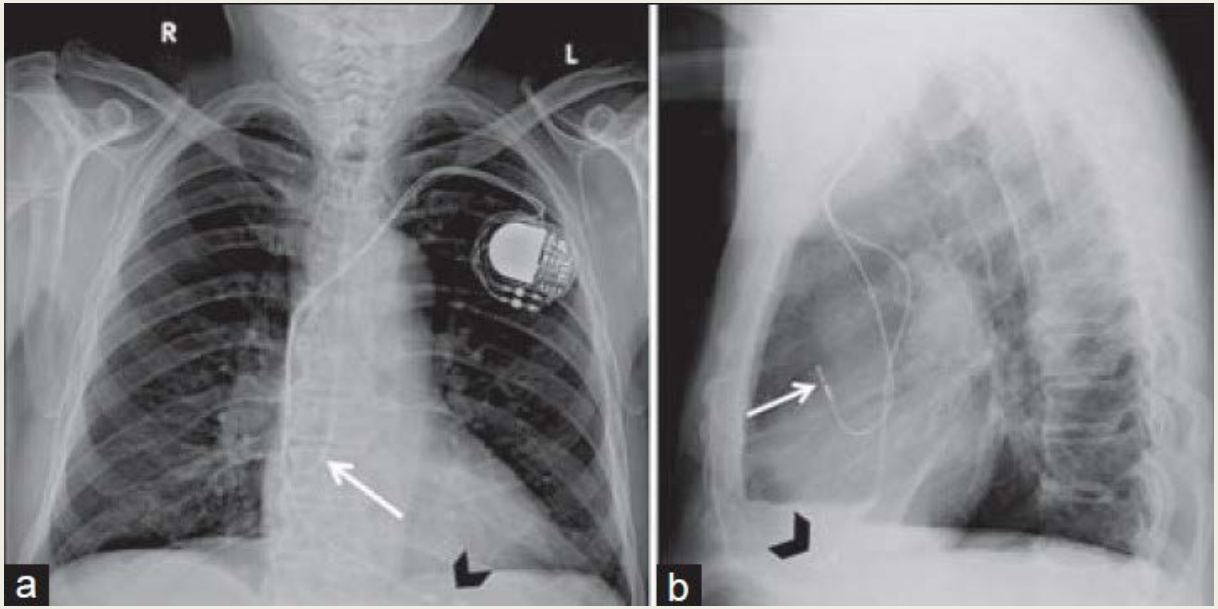
LCZ696 was superior to enalapril in reducing the risks of death and of hospitalization for heart failure. (Funded by Novartis; PARADIGM-HF ClinicalTrials.gov number, NCT01035255.)

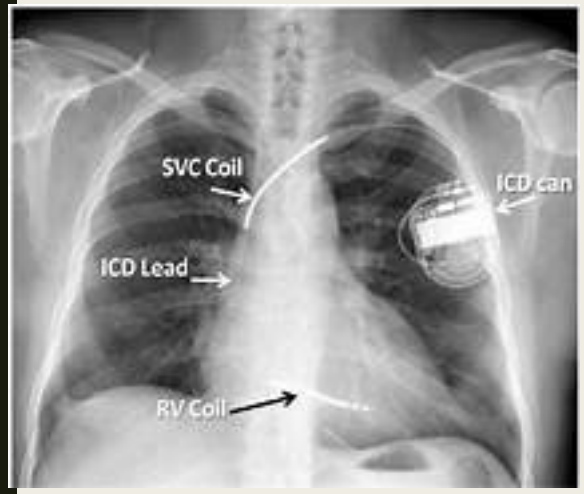
7.3.2.10. Renin-Angiotensin System Inhibition With Angiotensin-Converting Enzyme Inhibitor or Angiotensin Receptor Blocker or ARNI: Recommendations

Recommendations for Renin-Angiotensin System Inhibition With ACE Inhibitor or ARB or ARNI			
COR	**LOE**	**Recommendations**	**Comment/Rationale**
I	**ACE-I: A**	**The clinical strategy of inhibition of the renin-angiotensin system with ACE inhibitors *(Level of Evidence: A)* (128-133), OR ARBs *(Level of Evidence: A)* (134-137), OR ARNI *(Level of Evidence: B-R)* (138) in conjunction with evidence-based beta blockers (9, 139, 140), and aldosterone antagonists in selected patients (141, 142), is recommended for patients with chronic HF*r*EF to reduce morbidity and mortality.**	**NEW**: New clinical trial data prompted clarification and important updates.
	ARB: A		
	ARNI: B-R		

Recommendation for Ivabradine			
COR	**LOE**	**Recommendation**	**Comment/Rationale**
IIa	**B-R**	**Ivabradine can be beneficial to reduce HF hospitalization for patients with symptomatic (NYHA class II-III) stable chronic HF*r*EF (LVEF ≤35%) who are receiving GDEM*, including a beta blocker at maximum tolerated dose, and who are in sinus rhythm with a heart rate of 70 bpm or greater at rest (154-157).**	**NEW**: New clinical trial data.







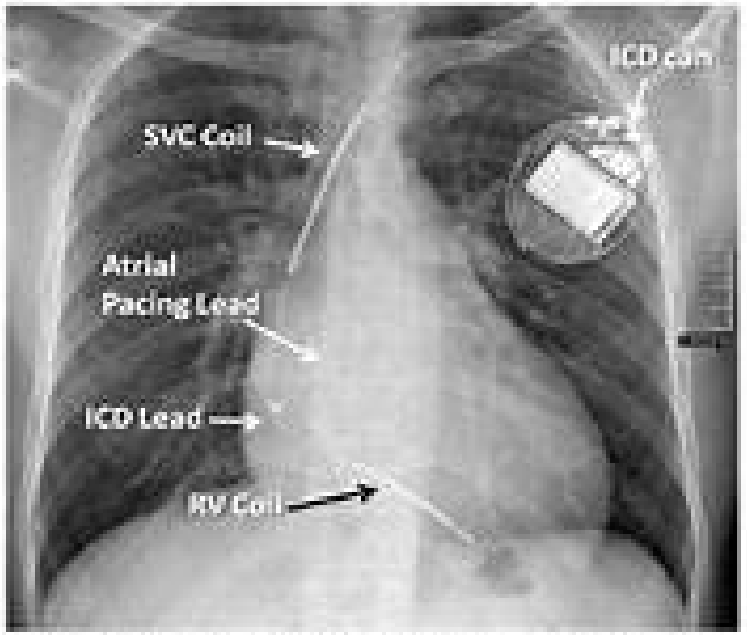
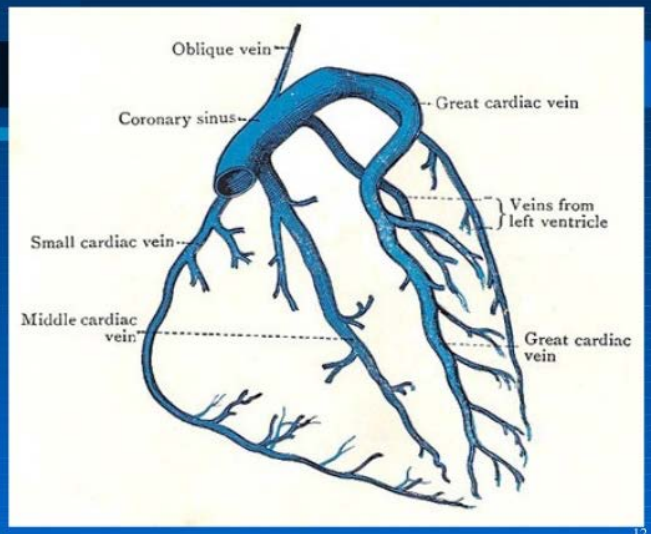
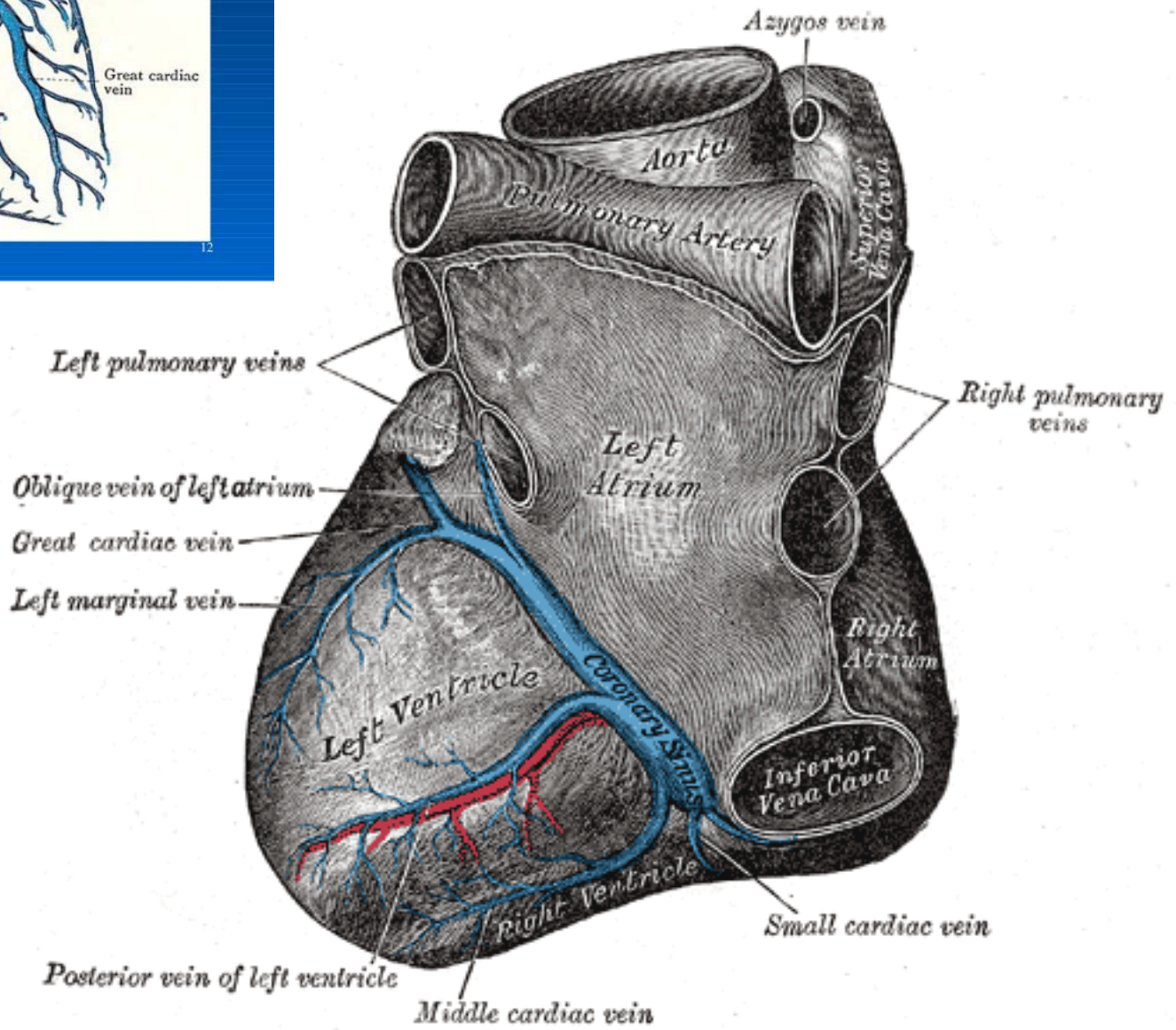
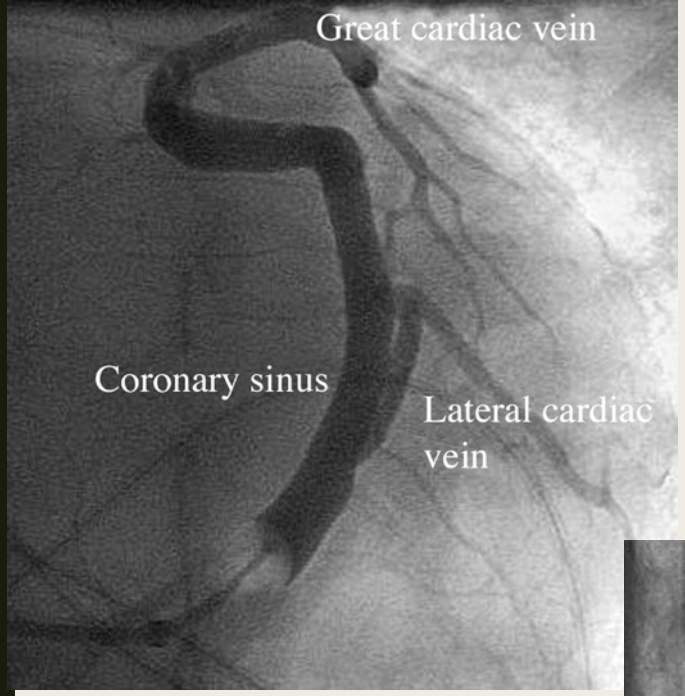
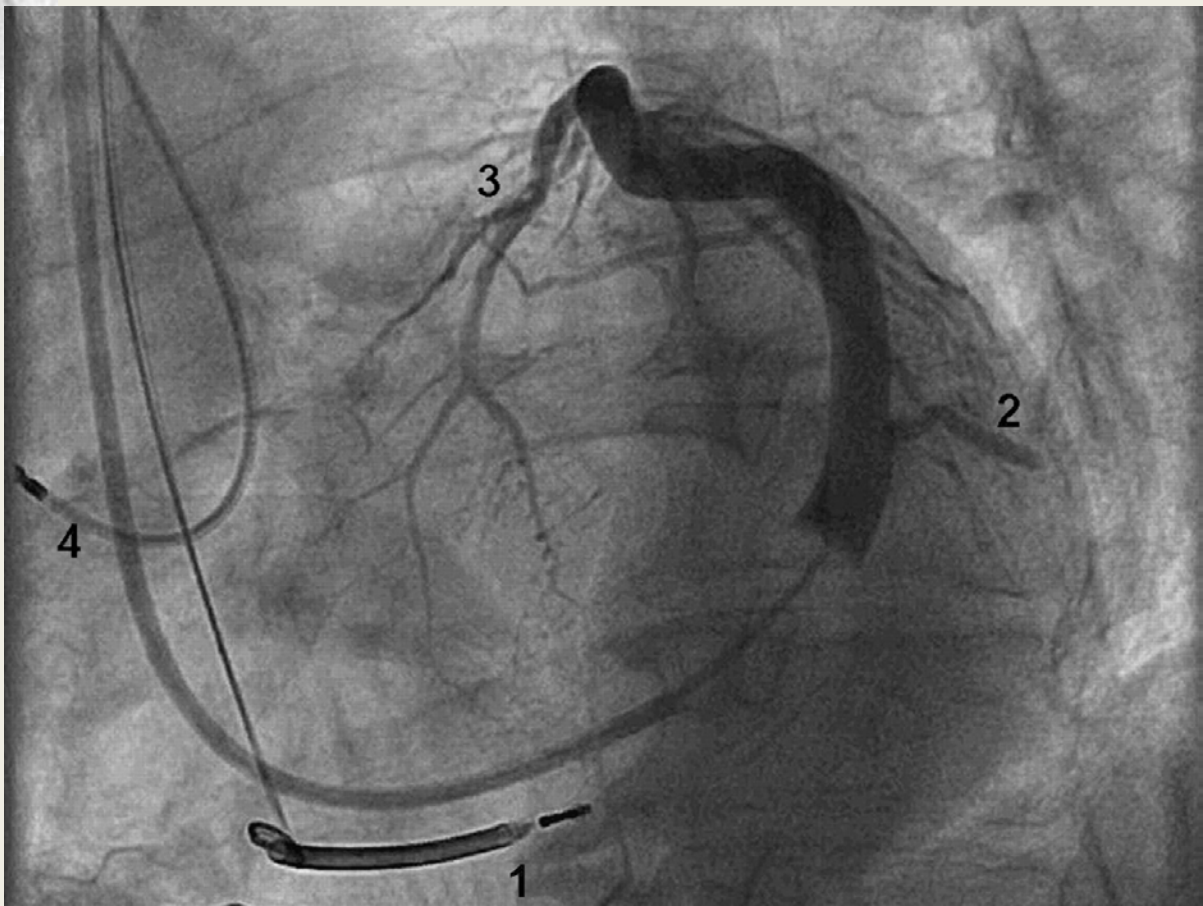


Figure 4. A dual-chamber ICD system with an active fixation dual-coil ICD lead at the right ventricular apex and another active fixation pacing lead in the right atrial lateral wall.


Oblique vein
Coronary sinus
Great cardiac vein
Veins from left ventricle
Small cardiac vein
Middle cardiac vein
Great cardiac vein
12


Azygos vein
Aorta
Pulmonary Artery
Superior Vena Cava
Left pulmonary veins
Right pulmonary veins
Left Atrium
Oblique vein of left atrium
Great cardiac vein
Left marginal vein
Right Atrium
Left Ventricle
Coronary Sinus
Inferior Vena Cava
Right Ventricle
Small cardiac vein
Posterior vein of left ventricle
Middle cardiac vein


Great cardiac vein
Coronary sinus
Lateral cardiac vein


3
2
4
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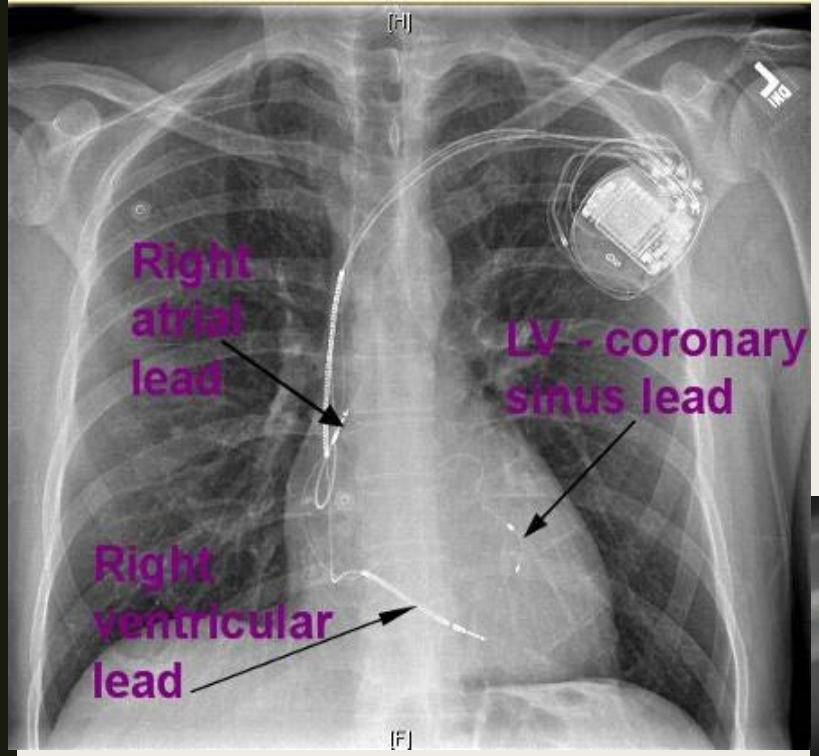
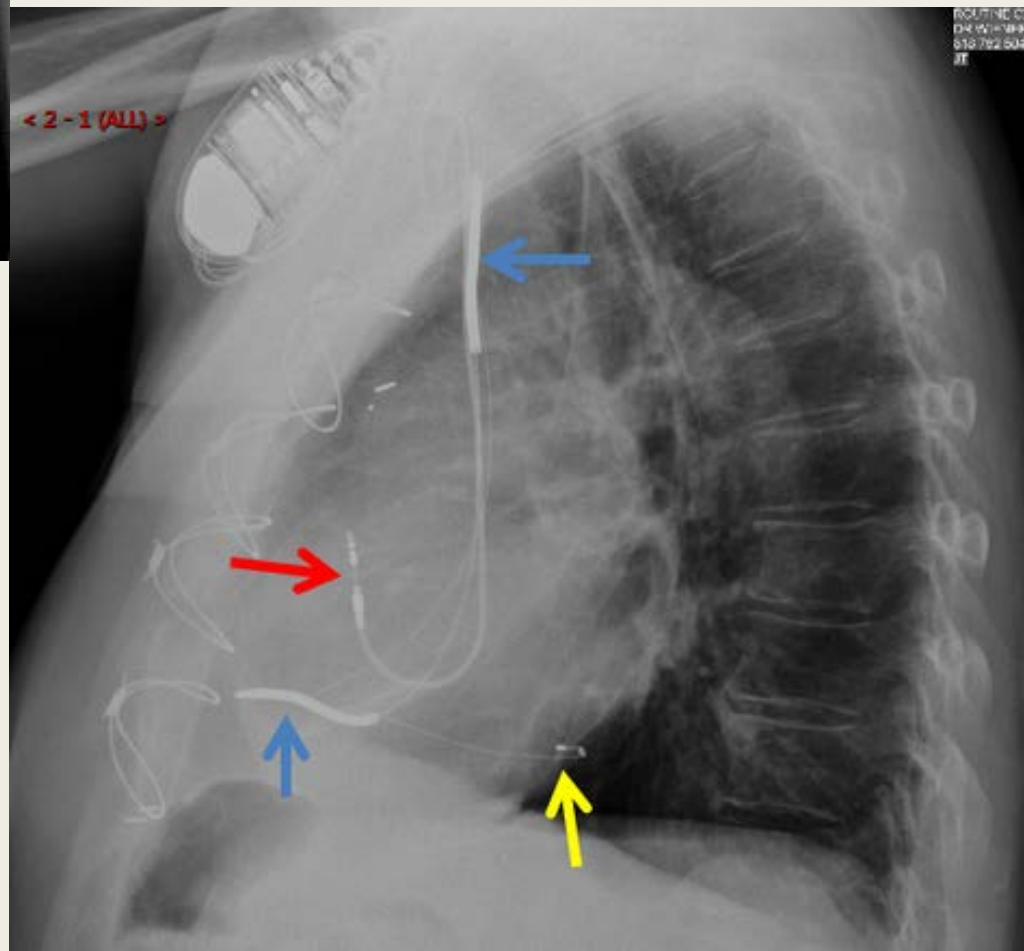

[H]
Right atrial lead
LV - coronary sinus lead
Right ventricular lead
[F]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The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 JANUARY 20, 2005 VOL. 352 NO. 3

Amiodarone or an Implantable Cardioverter–Defibrillator for Congestive Heart Failure

Gust H. Bardy, M.D., Kerry L. Lee, Ph.D., Daniel B. Mark, M.D., Jeanne E. Poole, M.D., Douglas L. Packer, M.D., Robin Boineau, M.D., Michael Domanski, M.D., Charles Troutman, R.N., Jill Anderson, R.N., George Johnson, B.S.E.E., Steven E. McNulty, M.S., Nancy Clapp-Channing, R.N., M.P.H., Linda D. Davidson-Ray, M.A., Elizabeth S. Fraulo, R.N., Daniel P. Fishbein, M.D., Richard M. Luceri, M.D., and John H. Ip, M.D., for the Sudden Cardiac Death in Heart Failure Trial (SCD-HeFT) Investigators*

METHODS

We randomly assigned 2521 patients with New York Heart Association (NYHA) class II or III CHF and a left ventricular ejection fraction (LVEF) of 35 percent or less to conventional therapy for CHF plus placebo (847 patients), conventional therapy plus amiodarone (845 patients), or conventional therapy plus a conservatively programmed, shock-only, single-lead ICD (829 patients). Placebo and amiodarone were administered in a double-blind fashion. The primary end point was death from any cause.

CONCLUSIONS

In patients with NYHA class II or III CHF and LVEF of 35 percent or less, amiodarone has no favorable effect on survival, whereas single-lead, shock-only ICD therapy reduces overall mortality by 23 percent.

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Cardiac-Resynchronization Therapy with or without an Implantable Defibrillator in Advanced Chronic Heart Failure

Michael R. Bristow, M.D., Leslie A. Saxon, M.D., John Boehmer, M.D., Steven Krueger, M.D., David A. Kass, M.D., Teresa De Marco, M.D., Peter Carson, M.D., Lorenzo DiCarlo, M.D., David DeMets, Ph.D., Bill G. White, Ph.D., Dale W. DeVries, B.A., and Arthur M. Feldman, M.D., Ph.D., for the Comparison of Medical Therapy, Pacing, and Defibrillation in Heart Failure (COMPANION) Investigators*

METHODS

A total of 1520 patients who had advanced heart failure (New York Heart Association class III or IV) due to ischemic or nonischemic cardiomyopathies and a QRS interval of at least 120 msec were randomly assigned in a 1:2:2 ratio to receive optimal pharmacologic therapy (diuretics, angiotensin-converting–enzyme inhibitors, beta-blockers, and spironolactone) alone or in combination with cardiac-resynchronization therapy with either a pacemaker or a pacemaker–defibrillator. The primary composite end point was the time to death from or hospitalization for any cause.

CONCLUSIONS

In patients with advanced heart failure and a prolonged QRS interval, cardiac-resynchronization therapy decreases the combined risk of death from any cause or first hospitalization and, when combined with an implantable defibrillator, significantly reduces mortality.

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 SEPTEMBER 29, 2016 VOL. 375 NO. 13

Defibrillator Implantation in Patients with Nonischemic Systolic Heart Failure

Lars Køber, M.D., D.M.Sc., Jens J. Thune, M.D., Ph.D., Jens C. Nielsen, M.D., D.M.Sc., Jens Haarbo, M.D., D.M.Sc., Lars Videbæk, M.D., Ph.D., Eva Korup, M.D., Ph.D., Gunnar Jensen, M.D., Ph.D., Per Hildebrandt, M.D., D.M.Sc., Flemming H. Steffensen, M.D., Niels E. Bruun, M.D., D.M.Sc., Hans Eiskjær, M.D., D.M.Sc., Axel Brandes, M.D., Anna M. Thøgersen, M.D., Ph.D., Finn Gustafsson, M.D., D.M.Sc., Kenneth Egstrup, M.D., D.M.Sc., Regitze Videbæk, M.D., Christian Hassager, M.D., D.M.Sc., Jesper H. Svendsen, M.D., D.M.Sc., Dan E. Høfsten, M.D., Ph.D., Christian Torp-Pedersen, M.D., D.M.Sc., and Steen Pehrson, M.D., D.M.Sc., for the DANISH Investigators*

METHODS

In a randomized, controlled trial, 556 patients with symptomatic systolic heart failure (left ventricular ejection fraction, ≤35%) not caused by coronary artery disease were assigned to receive an ICD, and 560 patients were assigned to receive usual clinical care (control group). In both groups, 58% of the patients received CRT. The primary outcome of the trial was death from any cause. The secondary outcomes were sudden cardiac death and cardiovascular death.

CONCLUSIONS

In this trial, prophylactic ICD implantation in patients with symptomatic systolic heart failure not caused by coronary artery disease was not associated with a significantly lower long-term rate of death from any cause than was usual clinical care. (Funded by Medtronic and others; DANISH ClinicalTrials.gov number, NCT00542945.)

Table 22. Recommendations for Device Therapy for Management of Stage C HF

Recommendations	COR	LOE
ICD therapy is recommended for primary prevention of SCD in selected patients with HF*r*EF at least 40 d post-MI with LVEF ≤35% and NYHA class II or III symptoms on chronic GDMT, who are expected to live >1 y*	I	A
CRT is indicated for patients who have LVEF ≤35%, sinus rhythm, LBBB with a QRS ≥150 ms, and NYHA class II, III, or ambulatory IV symptoms on GDMT	I	A (NYHA class III/IV) B (NYHA class II)
ICD therapy is recommended for primary prevention of SCD in selected patients with HF*r*EF at least 40 d post-MI with LVEF ≤30% and NYHA class I symptoms while receiving GDMT, who are expected to live >1 y*	I	B
CRT can be useful for patients who have LVEF ≤35%, sinus rhythm, a non-LBBB pattern with QRS ≥150 ms, and NYHA class III/ambulatory class IV symptoms on GDMT	IIa	A
CRT can be useful for patients who have LVEF ≤35%, sinus rhythm, LBBB with a QRS 120 to 149 ms, and NYHA class II, III, or ambulatory IV symptoms on GDMT	IIa	B
CRT can be useful in patients with AF and LVEF ≤35% on GDMT if a) the patient requires ventricular pacing or otherwise meets CRT criteria and b) AV nodal ablation or rate control allows near 100% ventricular pacing with CRT	IIa	B
CRT can be useful for patients on GDMT who have LVEF ≤35% and are undergoing new or replacement device implantation with anticipated ventricular pacing (>40%)	IIa	C
An ICD is of uncertain benefit to prolong meaningful survival in patients with a high risk of nonsudden death such as frequent hospitalizations, frailty, or severe comorbidities*	IIb	B
CRT may be considered for patients who have LVEF ≤35%, sinus rhythm, a non-LBBB pattern with a QRS duration of 120 to 149 ms, and NYHA class III/ambulatory class IV on GDMT	IIb	B
CRT may be considered for patients who have LVEF ≤35%, sinus rhythm, a non-LBBB pattern with QRS ≥150 ms, and NYHA class II symptoms on GDMT	IIb	B
CRT may be considered for patients who have LVEF ≤30%, ischemic etiology of HF, sinus rhythm, LBBB with QRS ≥150 ms, and NYHA class I symptoms on GDMT	IIb	C
CRT is not recommended for patients with NYHA class I or II symptoms and non-LBBB pattern with QRS <150 ms	III: No Benefit	B
CRT is not indicated for patients whose comorbidities and/or frailty limit survival to <1 y	III: No Benefit	C

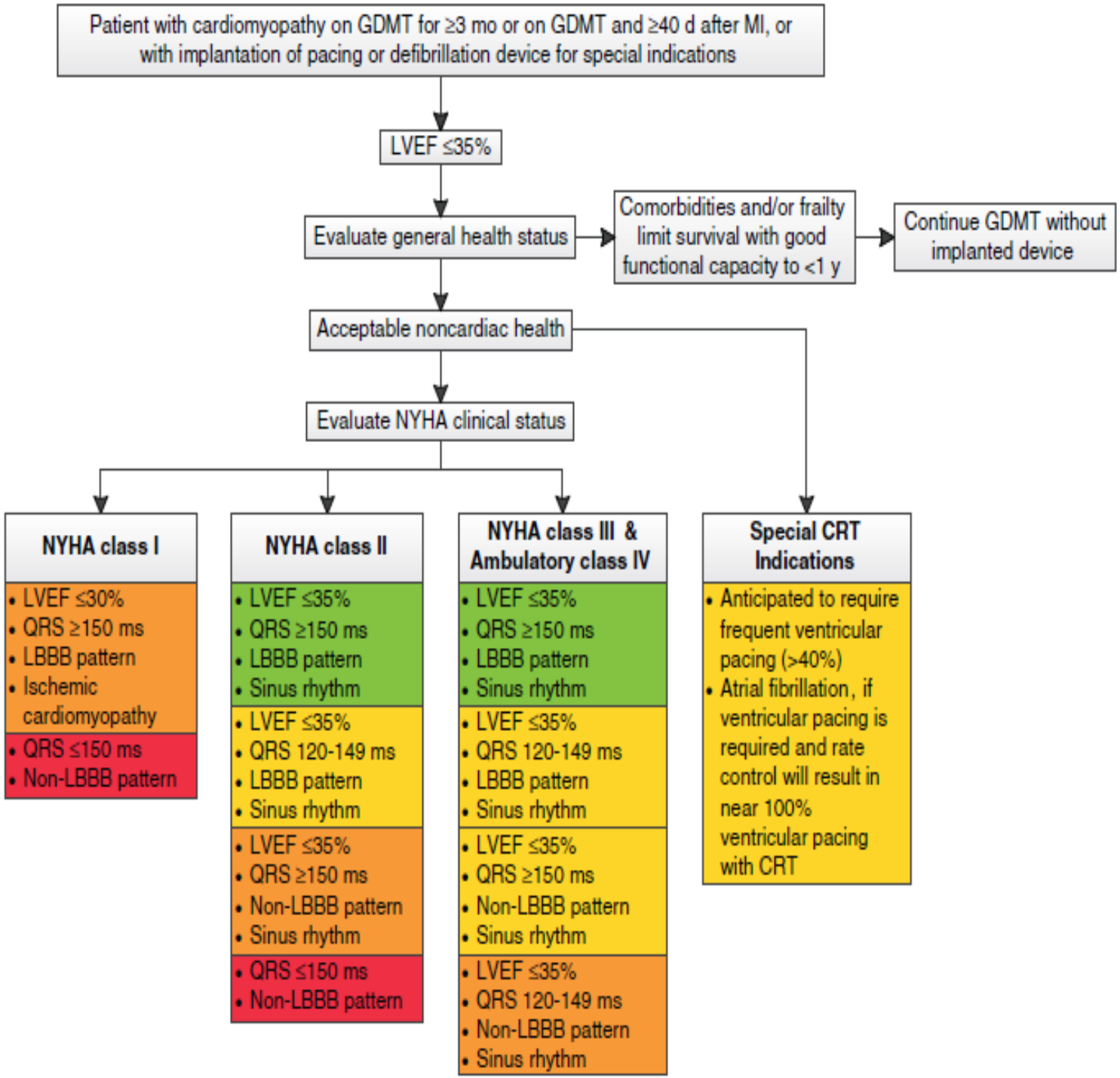

Patient with cardiomyopathy on GDMT for ≥3 mo or on GDMT and ≥40 d after MI, or with implantation of pacing or defibrillation device for special indications
LVEF ≤35%
Evaluate general health status
Comorbidities and/or frailty limit survival with good functional capacity to <1 y
Continue GDMT without implanted device
Acceptable noncardiac health
Evaluate NYHA clinical status
NYHA class I
• LVEF ≤30%
• QRS ≥150 ms
• LBBB pattern
• Ischemic cardiomyopathy
• QRS ≤150 ms
• Non-LBBB pattern
NYHA class II
• LVEF ≤35%
• QRS ≥150 ms
• LBBB pattern
• Sinus rhythm
• LVEF ≤35%
• QRS 120-149 ms
• LBBB pattern
• Sinus rhythm
• LVEF ≤35%
• QRS ≥150 ms
• Non-LBBB pattern
• Sinus rhythm
• QRS ≤150 ms
• Non-LBBB pattern
NYHA class III & Ambulatory class IV
• LVEF ≤35%
• QRS ≥150 ms
• LBBB pattern
• Sinus rhythm
• LVEF ≤35%
• QRS 120-149 ms
• LBBB pattern
• Sinus rhythm
• LVEF ≤35%
• QRS ≥150 ms
• Non-LBBB pattern
• Sinus rhythm
• LVEF ≤35%
• QRS 120-149 ms
• Non-LBBB pattern
• Sinus rhythm
Special CRT Indications
• Anticipated to require frequent ventricular pacing (>40%)
• Atrial fibrillation, if ventricular pacing is required and rate control will result in near 100% ventricular pacing with CRT

Figure 4. Primary Prevention of SCD in Patients With Ischemic Heart Disease

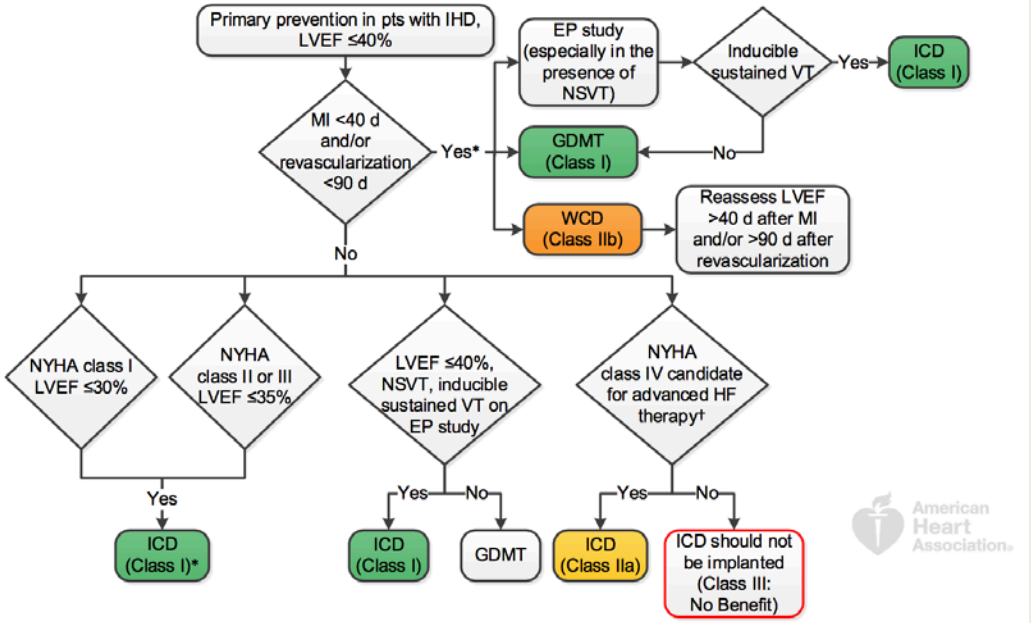


Figure 6. Secondary and Primary Prevention of SCD in Patients With NICM

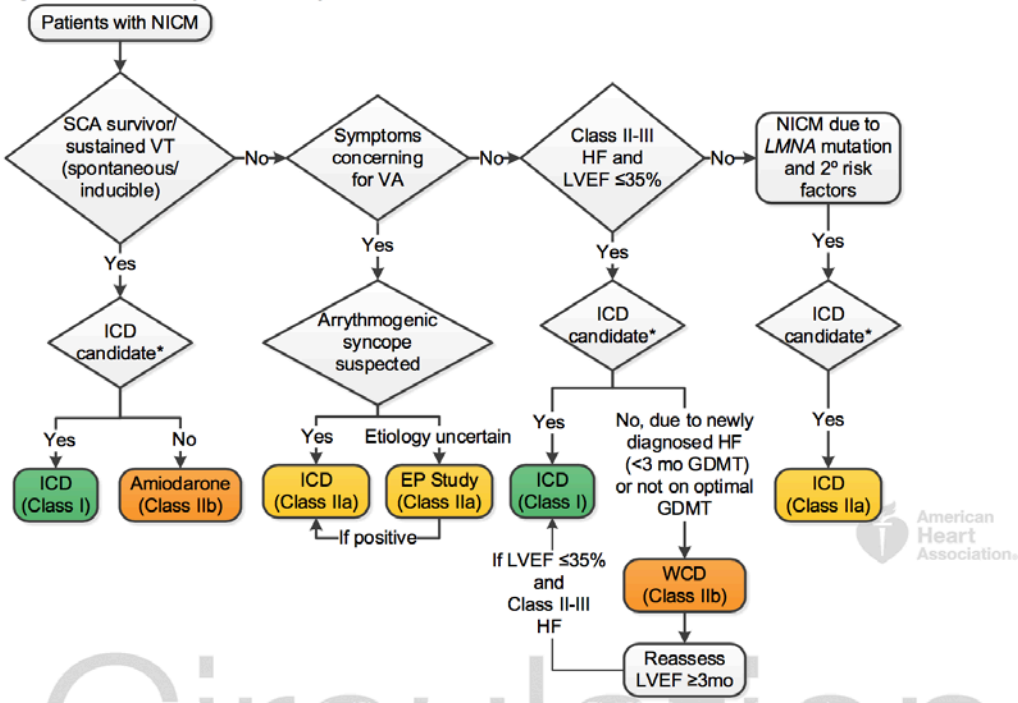
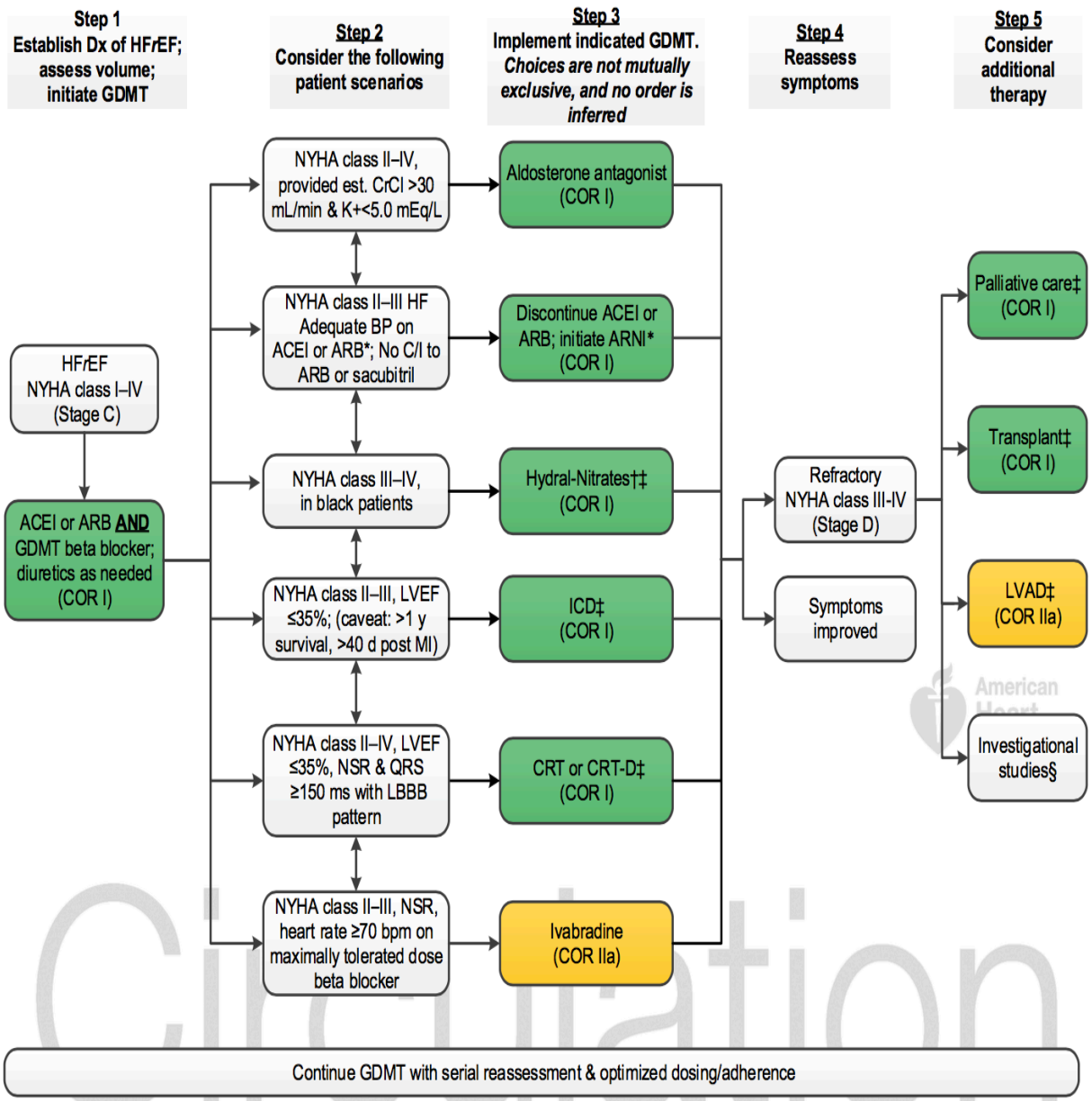


Figure 2. Treatment of HF*r*EF Stage C and D



2017 ACC/AHA/HFSA Heart Failure Focused Update

Recommendations for Stage C HF*p*EF			
COR	**LOE**	**Recommendations**	**Comment/Rationale**
I	B	**Systolic and diastolic blood pressure should be controlled in patients with HF*p*EF in accordance with published clinical practice guidelines to prevent morbidity (164, 165).**	2013 recommendation remains current.
I	C	**Diuretics should be used for relief of symptoms due to volume overload in patients with HF*p*EF.**	2013 recommendation remains current.
IIa	C	**Coronary revascularization is reasonable in patients with CAD in whom symptoms (angina) or demonstrable myocardial ischemia is judged to be having an adverse effect on symptomatic HF*p*EF despite GDMT.**	2013 recommendation remains current.
IIa	C	**Management of AF according to published clinical practice guidelines in patients with HF*p*EF is reasonable to improve symptomatic HF.**	2013 recommendation remains current (Section 9.1 in the 2013 HF guideline).
IIa	C	**The use of beta-blocking agents, ACE inhibitors, and ARBs in patients with hypertension is reasonable to control blood pressure in patients with HF*p*EF.**	2013 recommendation remains current.
IIb	B-R	**In appropriately selected patients with HF*p*EF (with EF ≥45%, elevated BNP levels or HF admission within 1 year, estimated glomerular filtration rate >30 mL/min, creatinine <2.5 mg/dL, potassium <5.0 mEq/L), aldosterone receptor antagonists might be considered to decrease hospitalizations (83, 166, 167).**	**NEW**: Current recommendation reflects new RCT data.
See Online Data Supplement C.			
IIb	B	**The use of ARBs might be considered to decrease hospitalizations for patients with HF*p*EF (169).**	2013 recommendation remains current.
III: No Benefit	B-R	**Routine use of nitrates or phosphodiesterase-5 inhibitors to increase activity or QoL in patients with HF*p*EF is ineffective (171, 172).**	**NEW**: Current recommendation reflects new data from RCTs.
See Online Data Supplement C.			
III: No Benefit	C	**Routine use of nutritional supplements is not recommended for patients with HF*p*EF.**	2013 recommendation remains current.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9.6. Sleep Disordered Breathing: Recommendations

(Moved from Section 7.3.1.4, Treatment of Sleep Disorders in the 2013 HF guideline.)

Recommendations for Treatment of Sleep Disorders			
COR	**LOE**	**Recommendations**	**Comment/Rationale**
IIa	**C-LD**	**In patients with NYHA class II–IV HF and suspicion of sleep disordered breathing or excessive daytime sleepiness, a formal sleep assessment is reasonable (200, 201).**	**NEW**: Recommendation reflects clinical necessity to distinguish obstructive versus central sleep apnea.
See Online Data Supplement G.			
Sleep disorders are common in patients with HF. A study of adults with chronic HF treated with evidence-based therapies found that 61% had either central or obstructive sleep apnea (202). It is clinically important to distinguish obstructive sleep apnea from central sleep apnea, given the different responses to treatment. Adaptive servo-ventilation for central sleep apnea is associated with harm (203). Continuous positive airway pressure (CPAP) for obstructive sleep apnea improves sleep quality, reduces the apnea-hypopnea index, and improves nocturnal oxygenation (200, 201).			
IIb	**B-R**	**In patients with cardiovascular disease and obstructive sleep apnea, CPAP may be reasonable to improve sleep quality and daytime sleepiness (204).**	**NEW**: New data demonstrate the limited scope of benefit expected from CPAP for obstructive sleep apnea.
See Online Data Supplement G.			
In patients with sleep apnea, a trial evaluated the impact of CPAP with usual therapy versus usual therapy alone on subsequent cardiovascular events, including HF (204). In this RCT of >2,700 patients, there was no evidence of benefit on cardiovascular events at a mean follow-up of 3.7 years for CPAP plus usual care compared with usual care alone. Improvements in sleep quality were noteworthy and represented the primary indication for initiating CPAP treatment (204). However, in patients with atrial fibrillation (AF) (a frequent comorbidity noted with HF), the use of CPAP for obstructive sleep apnea was helpful. In a trial of 10,132 patients with AF and obstructive sleep apnea, patients on CPAP treatment were less likely to progress to more permanent forms of AF than were patients without CPAP (205).			
III: Harm	**B-R**	**In patients with NYHA class II–IV HF*r*EF and central sleep apnea, adaptive servo-ventilation causes harm (203).**	**NEW**: New data demonstrate a signal of harm when adaptive servo-ventilation is used for central sleep apnea.
See Online Data Supplement G.			

Table 27. Recommendations for Inotropic Support, MCS, and Cardiac Transplantation

Recommendations	COR	LOE	References
Inotropic support			
Cardiogenic shock pending definitive therapy or resolution	I	C	N/A
BTT or MCS in stage D refractory to GDMT	IIa	B	647, 648
Short-term support for threatened end-organ dysfunction in hospitalized patients with stage D and severe HF*r*EF	IIb	B	592, 649, 650
Long-term support with continuous infusion palliative therapy in select stage D HF	IIb	B	651–653
Routine intravenous use, either continuous or intermittent, is potentially harmful in stage D HF	III: Harm	B	416, 654–659
Short-term intravenous use in hospitalized patients without evidence of shock or threatened end-organ performance is potentially harmful	III: Harm	B	592, 649, 650
MCS			
MCS is beneficial in carefully selected* patients with stage D HF in whom definitive management (eg, cardiac transplantation) is anticipated or planned	IIa	B	660–667
Nondurable MCS is reasonable as a "bridge to recovery" or "bridge to decision" for carefully selected* patients with HF and acute profound disease	IIa	B	668–671
Durable MCS is reasonable to prolong survival for carefully selected* patients with stage D HF*r*EF	IIa	B	672–675
Cardiac transplantation			
Evaluation for cardiac transplantation is indicated for carefully selected patients with stage D HF despite GDMT, device, and surgical management	I	C	680

*Although optimal patient selection for MCS remains an active area of investigation, general indications for referral for MCS therapy include patients with LVEF <25% and NYHA class III–IV functional status despite GDMT, including, when indicated, CRT, with either high predicted 1- to 2-year mortality (eg, as suggested by markedly reduced peak oxygen consumption and clinical prognostic scores) or dependence on continuous parenteral inotropic support. Patient selection requires a multidisciplinary team of experienced advanced HF and transplantation cardiologists, cardiothoracic surgeons, nurses and ideally, social workers and palliative care clinicians.

Table 29. Recommendations for Hospital Discharge

Recommendations or Indications	COR	LOE	References
Performance improvement systems in the hospital and early postdischarge outpatient setting to identify HF for GDMT	I	B	82, 365, 706, 792–796
Before hospital discharge, at the first postdischarge visit, and in subsequent follow-up visits, the following should be addressed: a. initiation of GDMT if not done or contraindicated; b. causes of HF, barriers to care, and limitations in support; c. assessment of volume status and blood pressure with adjustment of HF therapy; d. optimization of chronic oral HF therapy; e. renal function and electrolytes; f. management of comorbid conditions; g. HF education, self-care, emergency plans, and adherence; and h. palliative or hospice care	I	B	204, 795, 797–799
Multidisciplinary HF disease-management programs for patients at high risk for hospital readmission are recommended	I	B	82, 800–802
A follow-up visit within 7 to 14 d and/or a telephone follow-up within 3 d of hospital discharge are reasonable	IIa	B	101, 803
Use of clinical risk-prediction tools and/or biomarkers to identify higher-risk patients are reasonable	IIa	B	215

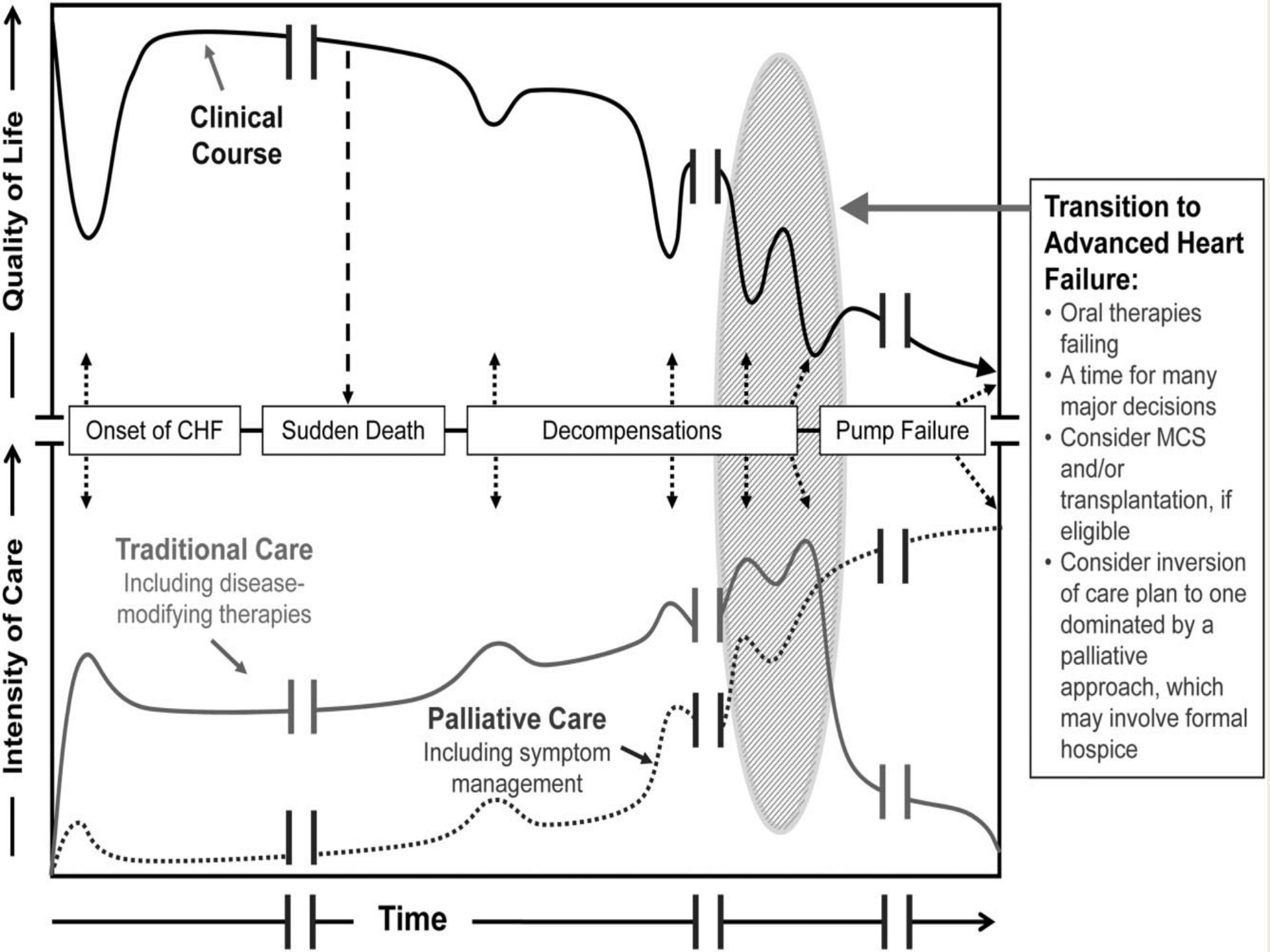
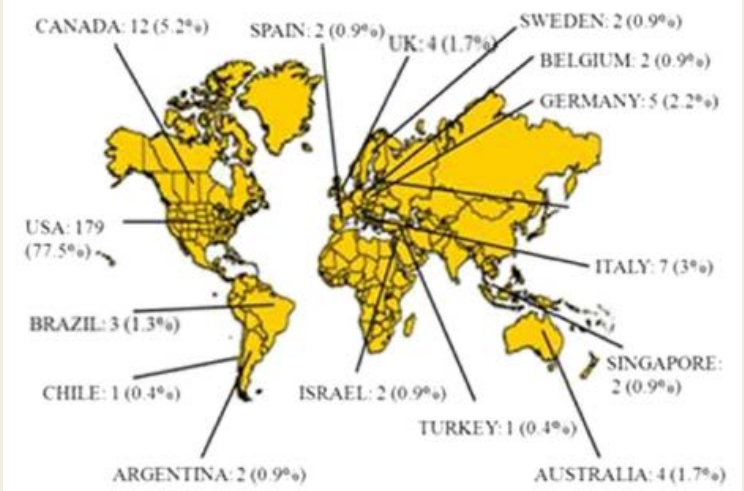

Quality of Life
Clinical Course
Onset of CHF
Sudden Death
Decompensations
Pump Failure
Transition to Advanced Heart Failure:
• Oral therapies failing
• A time for many major decisions
• Consider MCS and/or transplantation, if eligible
• Consider inversion of care plan to one dominated by a palliative approach, which may involve formal hospice
Intensity of Care
Traditional Care
Including disease-modifying therapies
Palliative Care
Including symptom management
Time

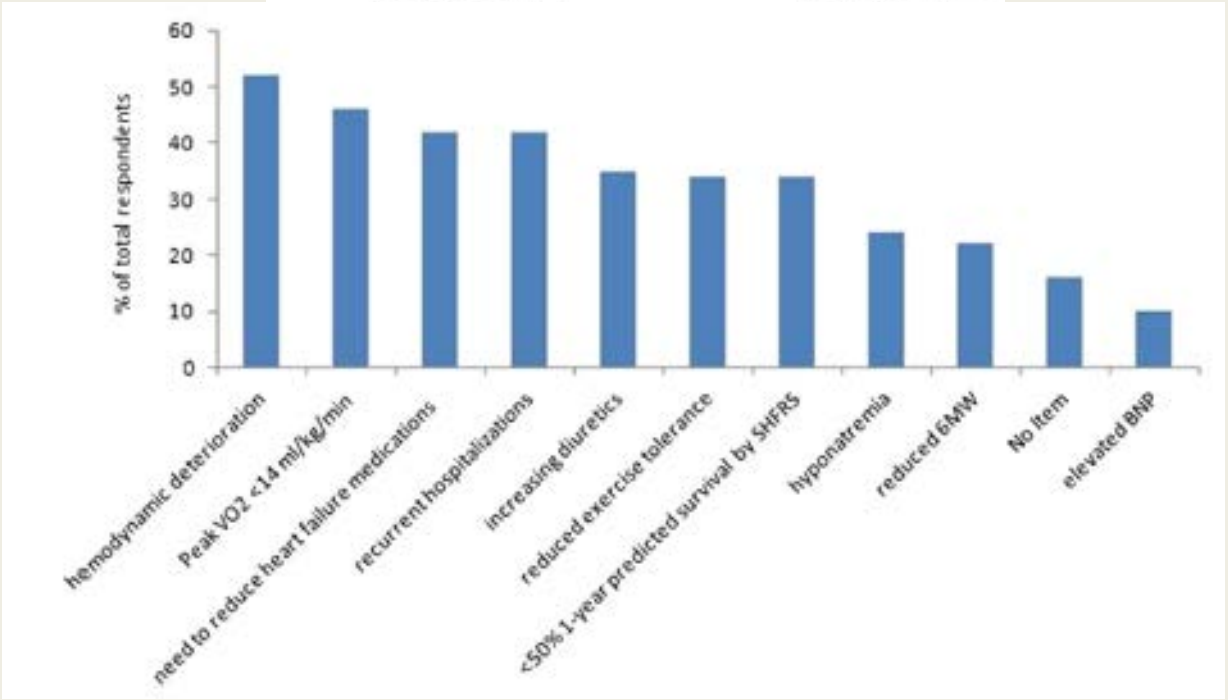
Table 23. ESC Definition of Advanced HF

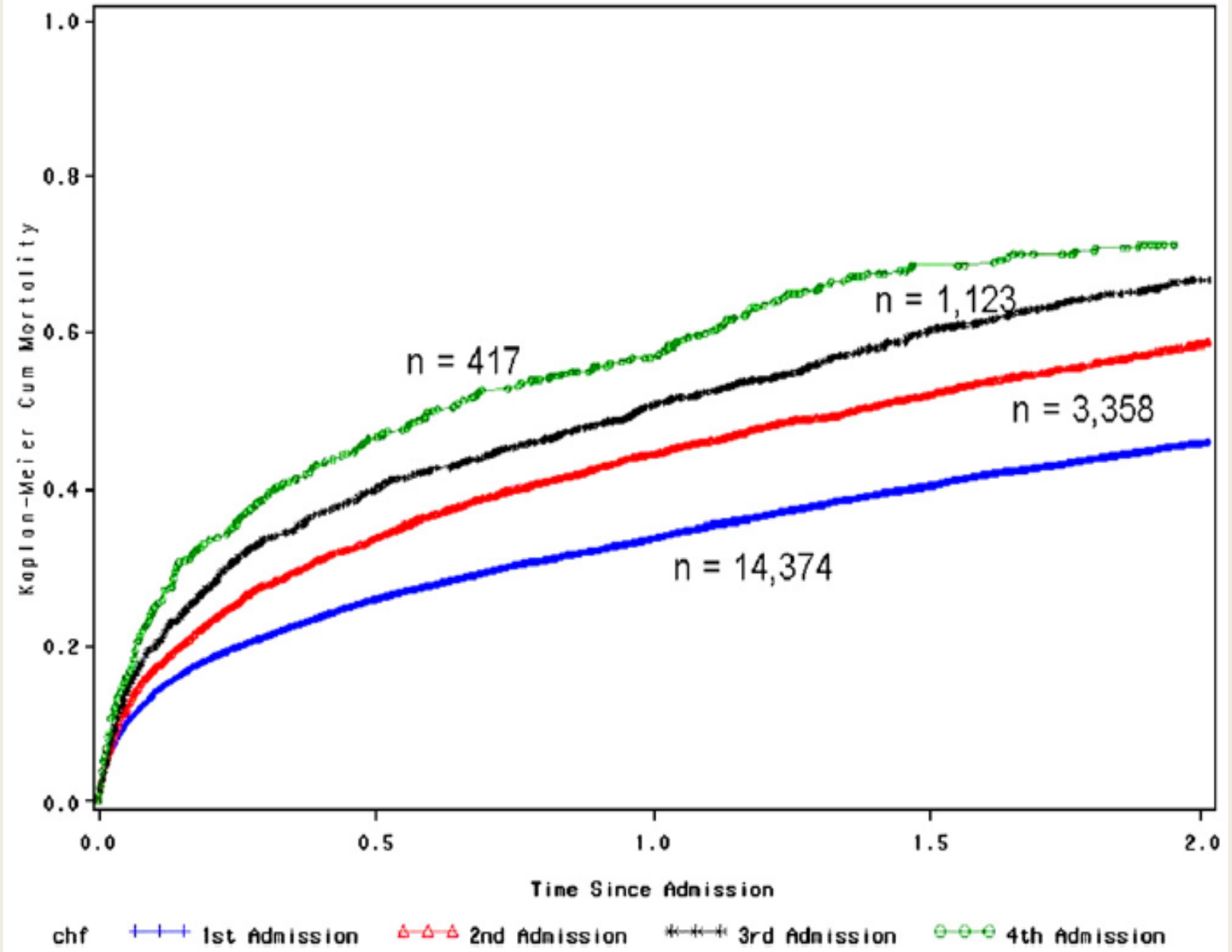
1. Severe symptoms of HF with dyspnea and/or fatigue at rest or with minimal exertion (NYHA class III or IV)
2. Episodes of fluid retention (pulmonary and/or systemic congestion, peripheral edema) and/or reduced cardiac output at rest (peripheral hypoperfusion)
3. Objective evidence of severe cardiac dysfunction shown by at least 1 of the following:
   a. LVEF <30%
   b. Pseudonormal or restrictive mitral inflow pattern
   c. Mean PCWP >16 mm Hg and/or RAP >12 mm Hg by PA catheterization
   d. High BNP or NT-proBNP plasma levels in the absence of noncardiac causes
4. Severe impairment of functional capacity shown by 1 of the following:
   a. Inability to exercise
   b. 6-Minute walk distance ≤300 m
   c. Peak $\dot{V}o_2$ <12 to 14 mL/kg/min
5. History of ≥1 HF hospitalization in past 6 mo
6. Presence of all the previous features despite "attempts to optimize" therapy, including diuretics and GDMT, unless these are poorly tolerated or contraindicated, and CRT when indicated

Table 24. Clinical Events and Findings Useful for Identifying Patients With Advanced HF

Repeated (≥2) hospitalizations or ED visits for HF in the past year
Progressive deterioration in renal function (eg, rise in BUN and creatinine)
Weight loss without other cause (eg, cardiac cachexia)
Intolerance to ACE inhibitors due to hypotension and/or worsening renal function
Intolerance to beta blockers due to worsening HF or hypotension
Frequent systolic blood pressure <90 mm Hg
Persistent dyspnea with dressing or bathing requiring rest
Inability to walk 1 block on the level ground due to dyspnea or fatigue
Recent need to escalate diuretics to maintain volume status, often reaching daily furosemide equivalent dose >160 mg/d and/or use of supplemental metolazone therapy
Progressive decline in serum sodium, usually to <133 mEq/L
Frequent ICD shocks


CANADA: 12 (5.2%)
SPAIN: 2 (0.9%)
UK: 4 (1.7%)
SWEDEN: 2 (0.9%)
BELGIUM: 2 (0.9%)
GERMANY: 5 (2.2%)
USA: 179 (77.5%)
ITALY: 7 (3%)
BRAZIL: 3 (1.3%)
SINGAPORE: 2 (0.9%)
CHILE: 1 (0.4%)
ISRAEL: 2 (0.9%)
TURKEY: 1 (0.4%)
ARGENTINA: 2 (0.9%)
AUSTRALIA: 4 (1.7%)


% of total respondents
60
50
40
30
20
10
0
hemodynamic deterioration
Peak VO2 <14 ml/kg/min
need to reduce heart failure medications
recurrent hospitalizations
increasing diuretics
reduced exercise tolerance
<50% 1-year predicted survival by SHFRS
hyponatremia
reduced 6MW
No item
elevated BNP



Kaplan-Meier cumulative mortality curve for all-cause mortality after each subsequent hospitalization for HF.

Am Heart J 2007;154:260-6.

Which patient has lower blood pressure?

- 1) A forty year-old man with EF:20%
- 2) A sixty year-old woman with EF:55%
- 3) A twenty year-old woman with EF:70%
- 4) A seventy year-old man with EF:30%
- 5) None of the above

Formula to Remember

- Blood flow is cardiac output (CO)
- BP ~ CO x SVR
- CO = HR x SV
- SV = EDV-ESV
- EF = EDV-ESV/EDV

Week 1

- You are seeing a 60 year-old African American patient with HFrEF (LVEF:20%) who has been discharged 5 days ago. This is his first f/u visit after two weeks of hospitalization and IV diuresis for ADHF. His weight upon discharge was 220 lbs.

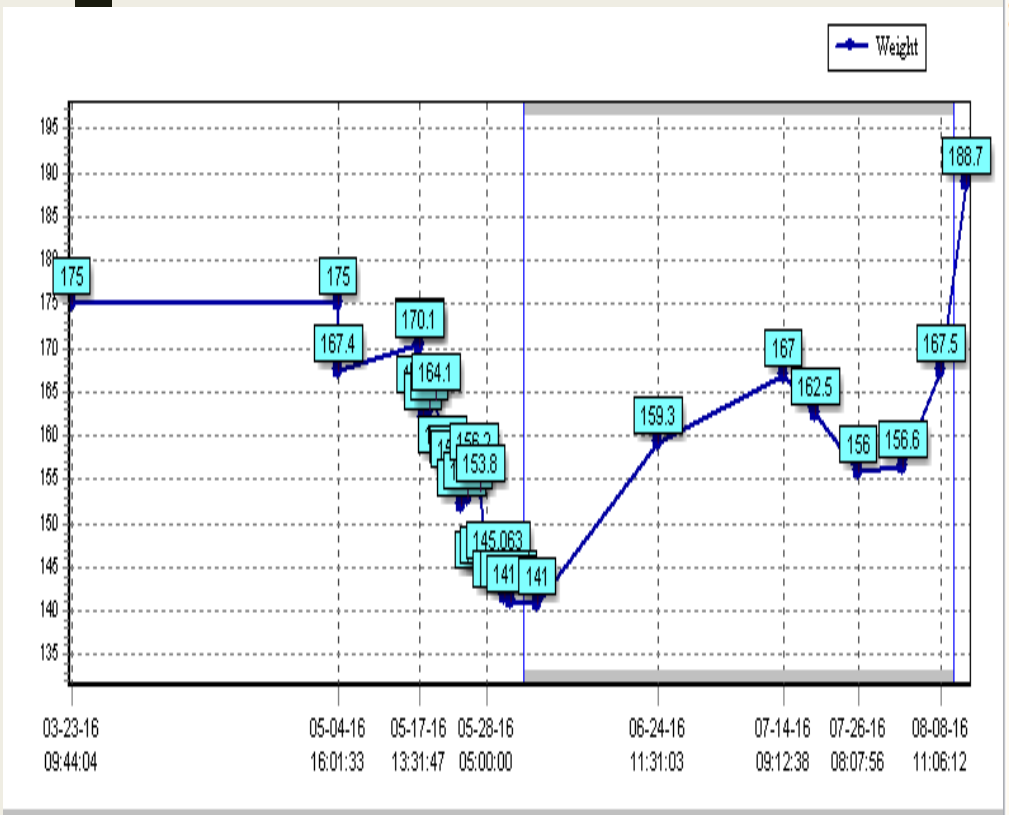
- Meds:
  - *Lisinopril: 5mg daily. Carvedilol 3.125mg BID, Furosemide: 80mg BID*

- On exam, BP:120/70mmHg, HR:84bpm, JVP:14CmH20
- Weight: 210 lbs (7 lbs below his dry weight).
- Serum Cr: 2.1 (discharge Cr:1.9); K:4.2

- 1) Continue the same dose of medications
- 2) Decrease furosemide to 80mg daily
- 3) Decrease furosemide to 40mg BID
- 4) Hold furosemide
- 4) Keep furosemide at the same dose; decrease lisinopril to 2.5mg daily

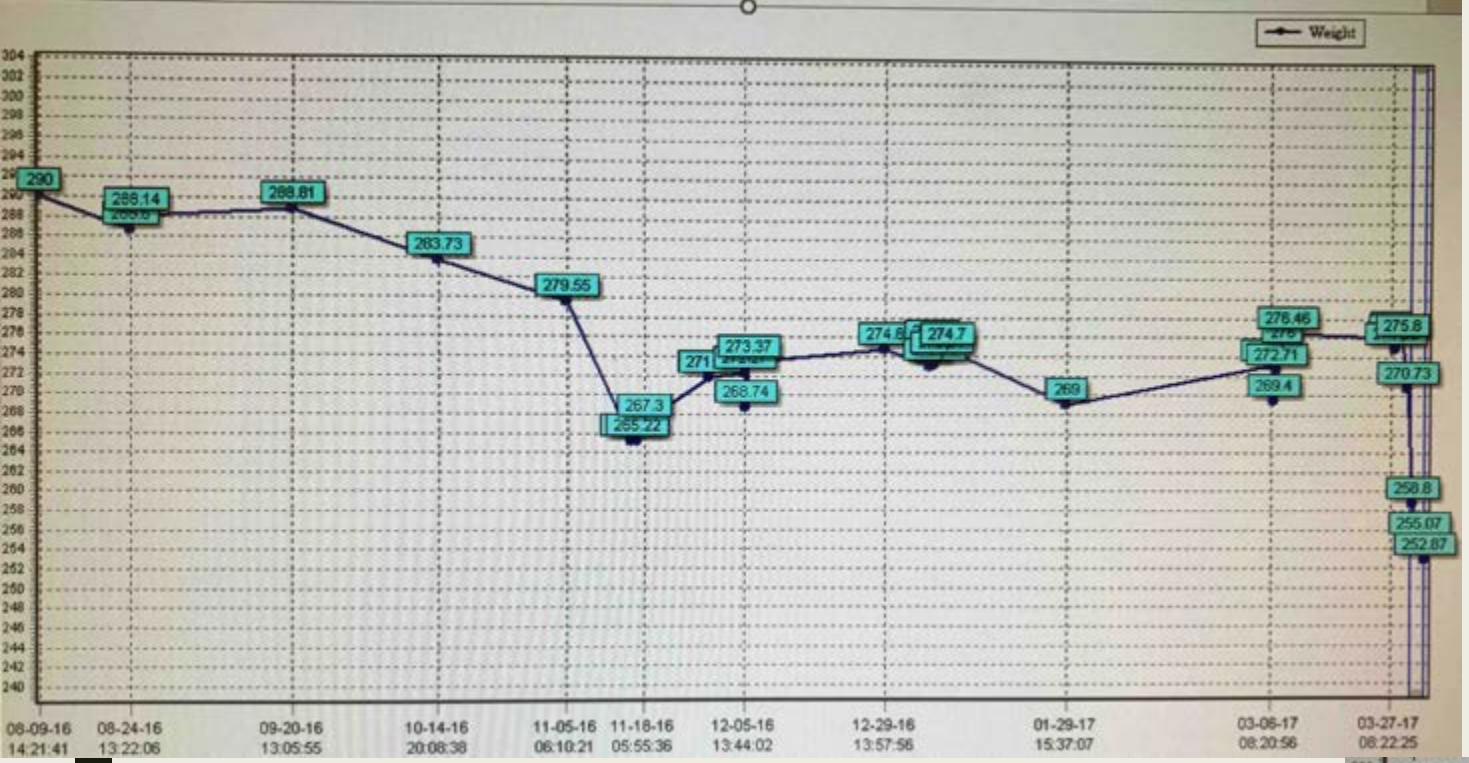
DRY WEIGHT IS A MYTH!

- Same Person
- Same Scale
- Same time
- Same cloths



06-05-16 08:38:04	06-24-16 11:31:03	07-14-16 09:12:38	07-19-16 07:54:16	07-26-16 08:07:56	08-02-16 08:40:28	08-08-16 11:06:12	08-12-16 09:44
97	97.8	99.1	98.5	98.2	98.5	97.8	97.1
110	100	100	105	95	91	93	90
18	18	18	18	16	18	18	18
100	99	98	96	99	100	100	98
113/84	101/66	103/71	105/76	107/71	90/67*	97/72	128/88
141	159.3	167	162.5	156	156.6	167.5	188.7
20.87	23.57	24.71	24.05	22.75	22.84	24.43	27.92*
69	69	69	69	69.5	69.5	69.5	69

Date	Weight(lbs)		Blood Pressure			Heart Rate	
(CST)	Time	Wt.	Time	Sys	Dias	Time	HR
08/24/2016			11:06	115	77	11:07	84
08/23/2016	11:04	150.0	11:07	113	76	11:08	96
08/22/2016	10:04	149.0	10:05	104	76	10:06	88
08/21/2016	11:06	151.0	11:08	111	78	11:09	96
08/20/2016	11:09	150.2	11:10	116	79	11:11	86
08/19/2016	11:08	150.0	11:09	117	84	11:10	93
08/18/2016	10:27	154.2	10:28	105	85	10:29	89
08/17/2016	10:25	155.2	10:26	114	70	10:27	99
08/16/2016	10:59	155.0	11:00	105	81	11:01	96
08/15/2016	10:34	156.2	10:36	120	86	10:37	93
08/14/2016	11:39	157.6	11:40	116	77	11:41	94
08/13/2016	11:26	158.0	11:27	108	80	11:28	85
08/12/2016	09:54	159.2	09:56	118	80	09:56	85
08/11/2016	10:22	160.0	10:23	109	75	10:24	93
08/10/2016	10:58	161.0	11:00	107	77	11:01	88
08/09/2016	11:04	163.0	11:06	107	69	11:06	81
08/08/2016	11:35	160.0	11:36	108	74	11:37	87
08/07/2016	10:43	157.0	10:44	108	74	10:45	74
08/06/2016	10:33	155.0	10:35	108	69	10:36	78
08/05/2016	10:59	152.4	11:01	112	74	11:01	80
08/04/2016	10:49	148.4	10:50	101	75	10:51	76
08/03/2016	10:57	148.6	10:58	108	78	10:59	82
08/02/2016	11:39	145.6	11:40	110	83	11:41	87
08/01/2016	11:01	140.0	11:03	106	74	11:04	87
07/31/2016	10:48	148.6	10:50	115	82	10:51	88
07/30/2016	11:07	151.4	11:09	113	87	11:10	89
07/29/2016	10:00	150.4	10:02	106	76	10:03	85
07/28/2016	10:25	153.8	10:27	107	74	10:27	89
07/27/2016	11:01	154.0	11:03	108	74	11:03	84


Weight
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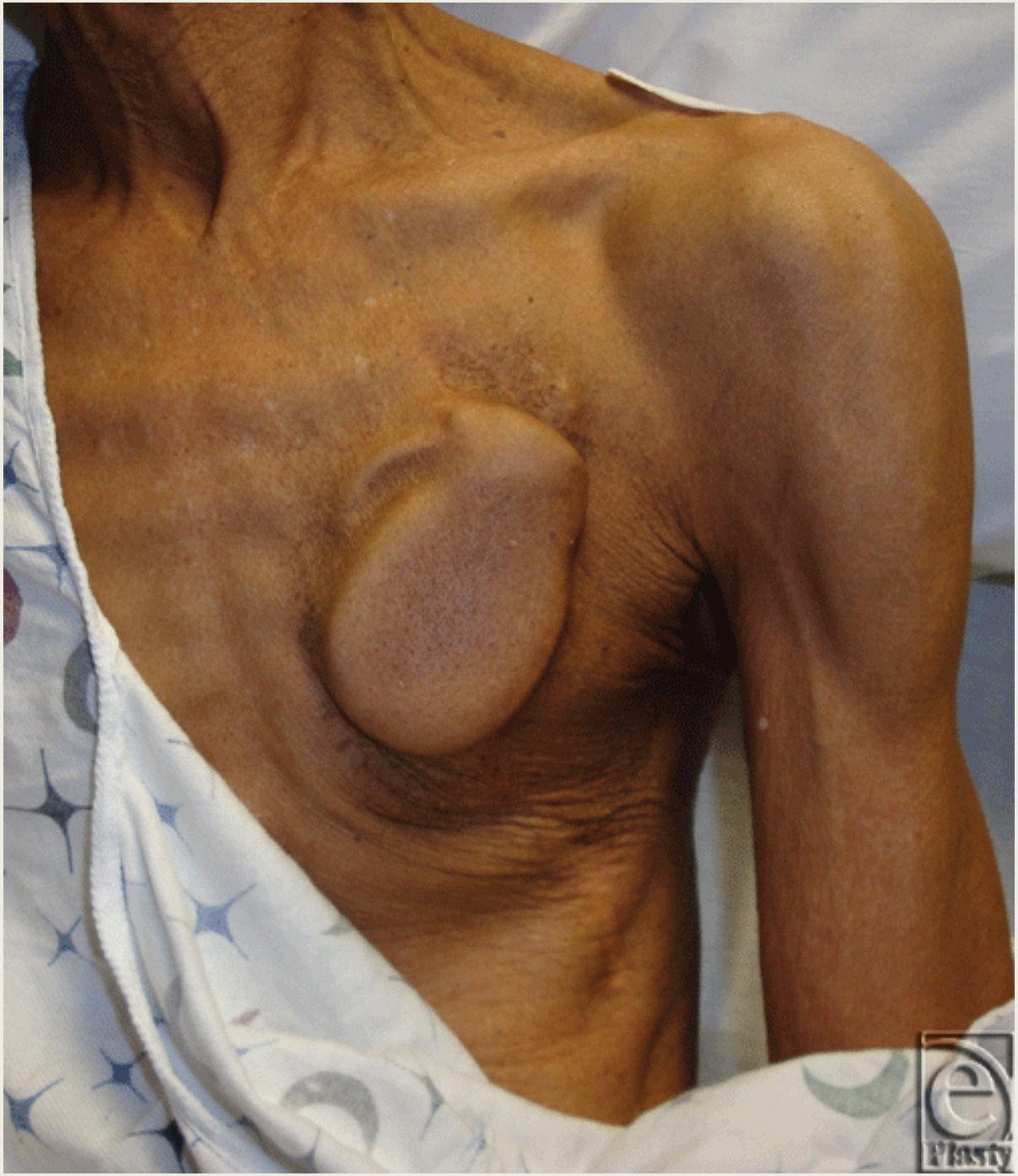
288.14
288.81
283.73
279.55
267.3
265.22
271
273.37
268.74
274.8
274.7
269
276.46
272.71
269.4
275.8
270.73
258.8
255.07
252.87
08-09-16 14:21:41
08-24-16 13:22:06
09-20-16 13:05:55
10-14-16 20:08:38
11-05-16 06:10:21
11-18-16 05:55:36
12-05-16 13:44:02
12-29-16 13:57:56
01-29-17 15:37:07
03-06-17 08:20:56
03-27-17 08:22:25


276
274.92
275.8
270.73
258.8
255.07
252.87
03-27-17 08:22:25
03-29-17 04:43:53
03-30-17 05:45:00
03-31-17 05:14:57
04-01-17 05:03:39
04-02-17 05:43:07



Week 2

- Patient is back to your clinic, he feels great. He is ambulatory and is back to his baseline DOE at NYHA class II.

- Exam:
  - *BP:110/66mmHg, HR:84bpm, JVP:8CmH20, Weight:204 lbs*

- Serum Cr:2; K:3.8

- 1) Increase carvedilol to 6.25mg BID
- 2) Increase lisinopril to 10mg daily
- 3) No change in his medications, as he is back to his baseline and feels great.
- 4) Decrease his furosemide in preparation for uptitration of his HF medications.
- 5) It does not really matter whether you increase lisinopril or carvedilol, but you should start uptitration.

Impact of Initiating Carvedilol Before Angiotensin-Converting Enzyme Inhibitor Therapy on Cardiac Function in Newly Diagnosed Heart Failure

Karen Sliwa, MD, PHD,* Gavin R. Norton, MD, PHD,‡ Ngalulawa Kone, MD,† Geoffrey Candy, PHD,* John Kachope, MD,* Angela J. Woodiwiss, PHD,‡ Carlos Libhaber, MD,* Pinhas Sareli, MD,* Rafique Essop, MD*

Johannesburg, South Africa

OBJECTIVES The purpose of this research was to evaluate the therapeutic value of initiating a beta-blocker before an angiotensin-converting enzyme inhibitor (ACEI) in the treatment of heart failure.

BACKGROUND Although ACEI and carvedilol produce benefits in heart failure, whether the order of initiation of therapy determines the impact on left ventricular (LV) function and New York Heart Association functional class (NYHA FC) has not been determined.

METHODS A single-center, prospective, randomized, open-label study was performed. We evaluated whether initiation of therapy with carvedilol either before ($n = 38$) or after ($n = 40$) perindopril therapy in newly diagnosed patients in NYHA FC II to III heart failure with idiopathic dilated cardiomyopathy, with the addition of the alternative agent after six months, determined subsequent changes in NYHA FC and LV function (echocardiography and radionuclide ventriculography). Study drugs were titrated to maximum tolerable doses.

RESULTS There were no differences in baseline characteristics between the study groups. After 12 months 11 patients died (6 in the group where the ACEI was initiated). At 12 months the group receiving carvedilol as initial therapy achieved a higher tolerable dose of carvedilol (43 $\pm$ 17 mg vs. 33 $\pm$ 18 mg, $p = 0.03$); a lower dose of furosemide ($p < 0.05$); and better improvements in symptoms (NYHA FC, $p < 0.002$), LV ejection fraction (radionuclide: 15 $\pm$ 16% vs. 6 $\pm$ 13%, $p < 0.05$; echocardiographic, $p < 0.01$), and plasma N-terminal pro-brain natriuretic peptide concentrations ($p < 0.02$).

CONCLUSIONS As opposed to the conventional sequence of drug use in the treatment of heart failure, initiation of therapy with carvedilol before an ACEI results in higher tolerable doses of carvedilol and better improvements in FC and LV function. (J Am Coll Cardiol 2004;44: 1825–30)

Week 4

- You increased carvedilol to 6.25mg BID and he has tolerated it well. His weight has remained stable at 205 lbs and has stable DOE at NYHA class II.

- On exam:
  - *BP:106/64mmHg, HR:80bpm, JVP:8Cm H20*

- Serum Cr:2; K:3.6.

- 1) Start Spironolactone at 25mg daily
- 2) Start Hydralazine/nitrate
- 3) Decrease furosemide due to borderline low serum potassium
- 4) Add KCl at 20mEq daily
- 5) No change in his medication in this visit

Aldosterone receptor antagonists		
Aldosterone receptor antagonists are recommended in patients with NYHA class II–IV who have LVEF ≤35%	I	A
Aldosterone receptor antagonists are recommended in patients following an acute MI who have LVEF ≤40% with symptoms of HF or DM	I	B
Inappropriate use of aldosterone receptor antagonists may be harmful	III: Harm	B
Hydralazine and isosorbide dinitrate		
The combination of hydralazine and isosorbide dinitrate is recommended for African Americans with NYHA class III–IV HF*r*EF on GDMT	I	A
A combination of hydralazine and isosorbide dinitrate can be useful in patients with HF*r*EF who cannot be given ACE inhibitors or ARBs	IIa	B

Table 13. Medical Therapy for Stage C HF*r*EF: Magnitude of Benefit Demonstrated in RCTs

GDMT	RR Reduction in Mortality (%)	NNT for Mortality Reduction (Standardized to 36 mo)	RR Reduction in HF Hospitalizations (%)
ACE inhibitor or ARB	17	26	31
Beta blocker	34	9	41
Aldosterone antagonist	30	6	35
Hydralazine/nitrate	43	7	33

Circulation. 2013;128:1810-1852.

Week 6

- He has been doing well, Completely asymptomatic during performing his ADLs. Stable DOE at NYHA class II. His weight has remained stable at 203 lbs.

- On exam:
  - *BP:90/62mmHg, HR:80 bpm, JVP:6Cm H20*

- Serum Cr:2.1; K:4.4.

- 1) Decrease furosemide to 80mg daily
- 2) Hold furosemide
- 3) Increase carvedilol to 9.375mg BID
- 4) Decrease spironolactone to 12.5mg daily
- 4) No change in his medication as he is doing well and borderline low BP

Formula to Remember

- Blood flow is cardiac output (CO)
- BP ~ CO x SVR
- CO = HR x SV
- SV = EDV-ESV
- EF = EDV-ESV/EDV

Date	Weight (lbs)		Blood Pressure			Heart Rate	
(CST)	Time	Wt.	Time	Sys	Dias	Time	HR
09/06/2016	09:16	150.1	09:15	76	50	09:15	60
09/05/2016	08:17	150.2	08:16	79	46	08:16	70
09/04/2016	09:55	151.6	09:54	81	47	09:54	64
09/03/2016	09:15	149.0	09:15	77	49	09:15	67
09/02/2016	09:29	150.8	09:28	84	52	09:28	70
09/01/2016	12:24	148.6	12:24	86	49	12:24	62
08/31/2016	10:32	147.9	10:31	81	55	10:31	65
08/30/2016	08:33	149.9	08:32	86	50	08:32	70
08/29/2016	11:27	150.4	11:27	91	56	11:27	68
08/28/2016	11:24	147.8	11:23	85	50	11:23	60
08/27/2016	10:57	147.6	10:56	81	48	10:56	62
08/26/2016	10:58	148.6	10:58	83	52	10:58	62
08/25/2016	11:37	146.2	11:36	72	46	11:36	59
08/24/2016	11:54	147.8	11:53	81	50	11:53	59
08/23/2016	10:29	149.0	10:28	81	50	10:28	60
08/22/2016	09:58	148.4	09:57	83	47	09:57	63
08/19/2016	08:14	150.8	08:13	77	54	08:13	65
08/18/2016	10:41	148.3	10:40	74	45	10:40	66
08/17/2016	09:45	150.1	09:45	80	45	09:45	60
08/16/2016	11:08	150.1	18:25	82	45	18:25	63
08/16/2016			11:07	70	44	11:07	60
08/15/2016	11:32	148.8	11:31	73	45	11:31	62
08/14/2016	10:39	149.7	10:39	75	47	10:39	60
08/13/2016	09:42	148.6	09:41	79	47	09:41	59
08/12/2016	10:01	151.5	10:00	87	53	10:00	59
08/11/2016	13:48	150.8	13:48	85	50	13:48	61
08/10/2016	10:05	150.5	10:04	78	44	10:04	60
08/09/2016	07:50	151.2	07:49	70	43	07:49	69
08/08/2016	09:24	147.9	09:23	80	46	09:23	59
Averages		149.4		80	48		63

The keyword is:

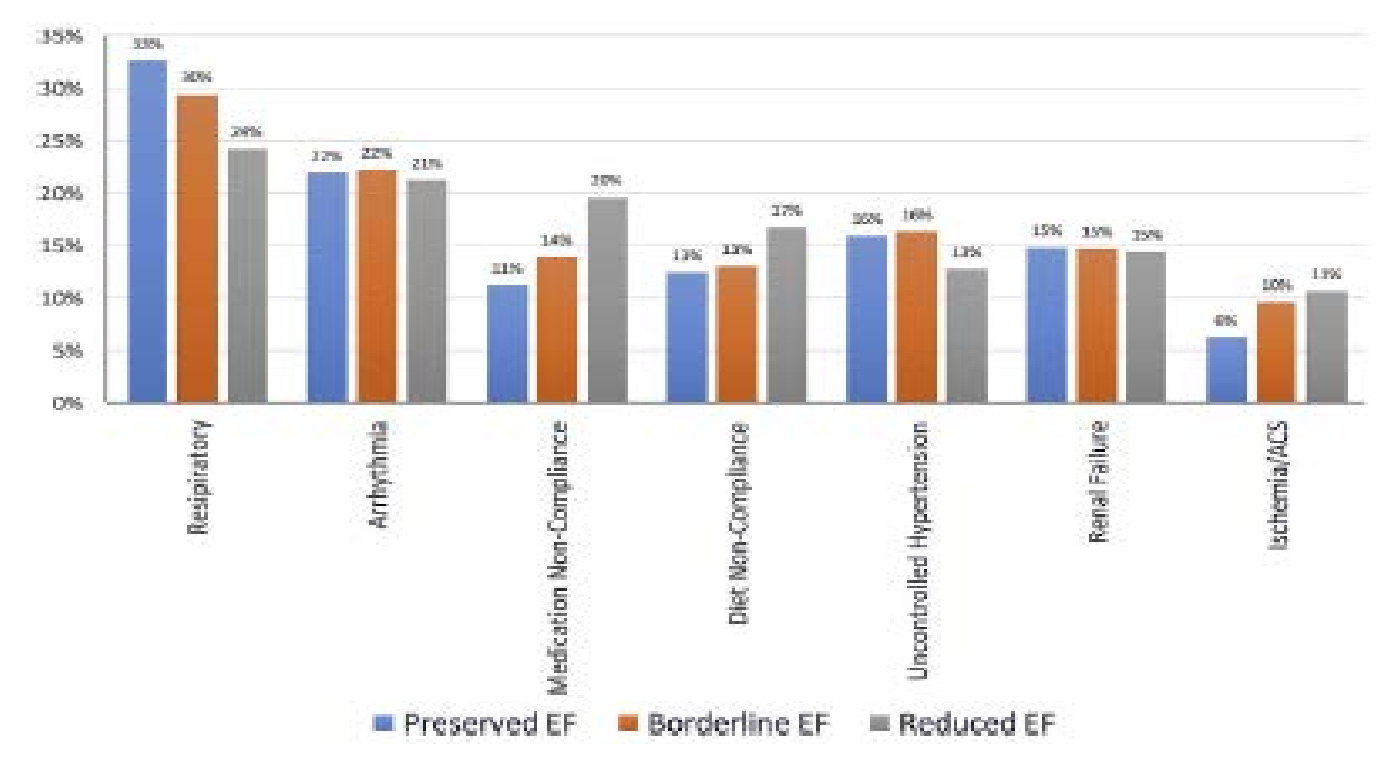
OPTIMIZATION

Week 40

- Patient loses follow-up and 9 months later presents to the ED and is admitted for IV diuresis for ADHF.

- What is the most common precipitating factor for hospital readmission?

- 1) Pneumonia/Respiratory process
- 2) Medication non-compliance
- 3) Diet non-compliance
- 4) Worsening renal failure
- 5) Uncontrolled hypertension
- 6) Ischemia/ACS



(J Am Coll Cardiol HF 2016;4:464-72)

WHO SHOULD ADMIT THEM?

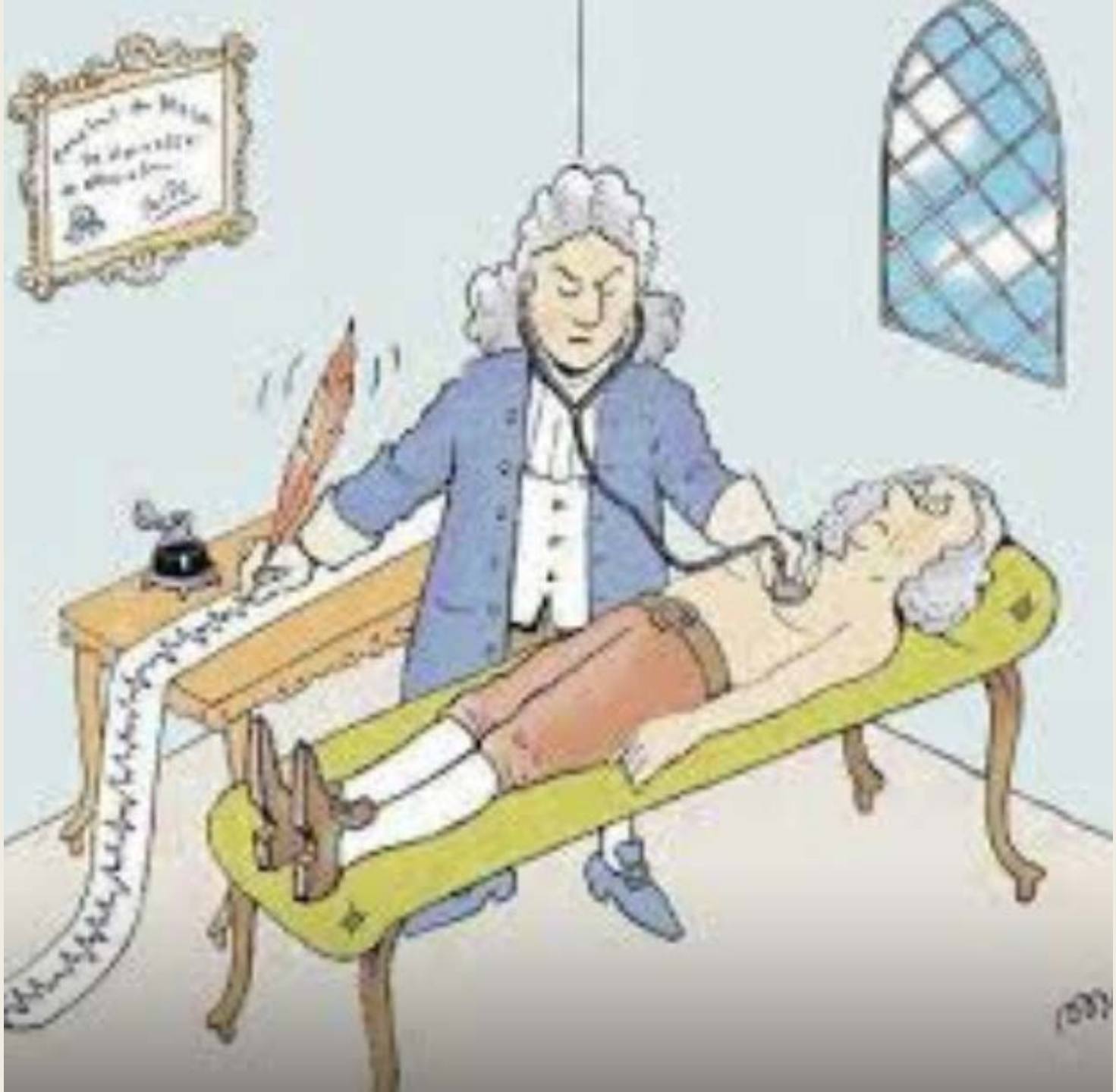
Associations Between Use of the Hospitalist Model and Quality of Care and Outcomes of Older Patients Hospitalized for Heart Failure

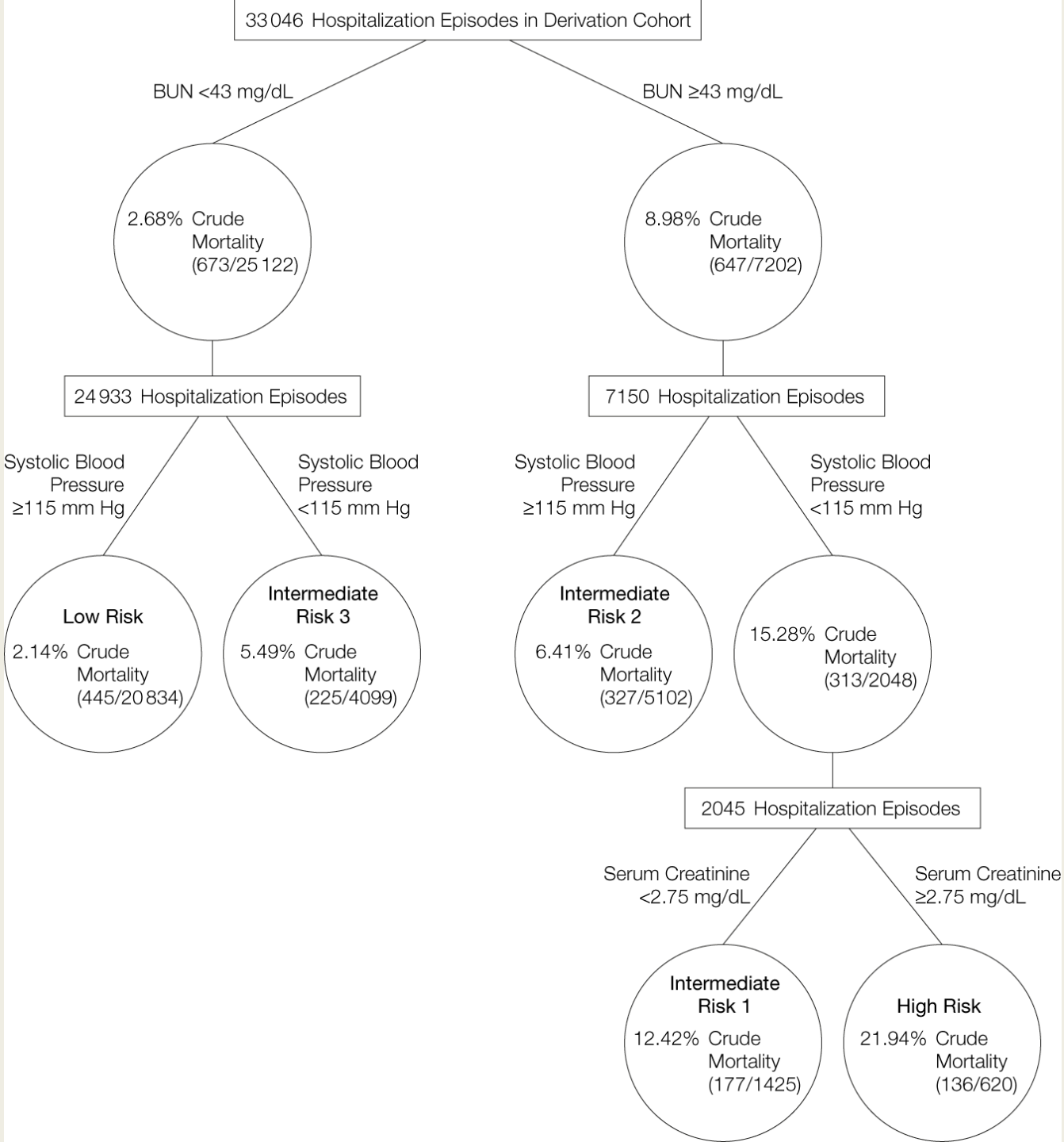
Methods We analyzed data from the Get With the Guidelines-Heart Failure registry linked to Medicare claims for 2005 through 2008. For each hospital, we calculated the percentage of heart failure hospitalizations for which a hospitalist was the attending physician. We examined outcomes and care quality for patients stratified by rates of hospitalist use. Using multivariable models, we estimated associations between hospital-level use of hospitalists and cardiologists and 30-day risk-adjusted outcomes and adherence to measures of quality care.

Results The analysis included 31,505 Medicare beneficiaries in 166 hospitals. Across hospitals, the use of hospitalists varied from 0% to 83%. After multivariable adjustment, a 10% increase in the use of hospitalists was associated with a slight increase in mortality (risk ratio: 1.03; 95% confidence interval [CI]: 1.00 to 1.06) and decrease in length of stay (0.09 days; 95% CI: 0.02 to 0.16). There was no association with 30-day readmission. Increased use of hospitalists in hospitals with high use of cardiologists was associated with improved defect-free adherence to a composite of heart failure performance measures (risk ratio: 1.03; 95% CI: 1.01 to 1.06).

Conclusions Hospitalist care varied significantly across hospitals for heart failure admissions and was not associated with improved 30-day outcomes. Comanagement by hospitalists and cardiologists may help to improve adherence to some quality measures, but it remains unclear what care model improves 30-day clinical outcomes. (J Am Coll Cardiol HF 2013;1:445–53)

WHERE TO ADMIT THEM?




33 046 Hospitalization Episodes in Derivation Cohort
BUN <43 mg/dL
BUN ≥43 mg/dL
2.68% Crude Mortality (673/25 122)
8.98% Crude Mortality (647/7202)
24 933 Hospitalization Episodes
7150 Hospitalization Episodes
Systolic Blood Pressure ≥115 mm Hg
Systolic Blood Pressure <115 mm Hg
Systolic Blood Pressure ≥115 mm Hg
Systolic Blood Pressure <115 mm Hg
Low Risk
2.14% Crude Mortality (445/20 834)
Intermediate Risk 3
5.49% Crude Mortality (225/4099)
Intermediate Risk 2
6.41% Crude Mortality (327/5102)
15.28% Crude Mortality (313/2048)
2045 Hospitalization Episodes
Serum Creatinine <2.75 mg/dL
Serum Creatinine ≥2.75 mg/dL
Intermediate Risk 1
12.42% Crude Mortality (177/1425)
High Risk
21.94% Crude Mortality (136/620)

Systolic BP	Points
50-59	28
60-69	26
70-79	24
80-89	23
90-99	21
100-109	19
110-119	17
120-129	15
130-139	13
140-149	11
150-159	9
160-169	8
170-179	6
180-189	4
190-199	2
≥200	0

BUN	Points
≤9	0
10-19	2
20-29	4
30-39	6
40-49	8
50-59	9
60-69	11
70-79	13
80-89	15
90-99	17
100-109	19
110-119	21
120-129	23
130-139	25
140-149	27
≥150	28

Sodium	Points
≤130	4
131	3
132	3
133	3
134	2
135	2
136	2
137	1
138	1
≥139	0

Age	Points
≤19	0
20-29	3
30-39	6
40-49	8
50-59	11
60-69	14
70-79	17
80-89	19
90-99	22
100-109	25
≥110	28

Heart Rate	Points
≤79	0
80-84	1
85-89	3
90-94	4
95-99	5
100-104	6
≥105	8

Black Race	Points
Yes	0
No	3

COPD	Points
Yes	2
No	0

Total Score	Probability of Death
0-33	**<1%**
34-50	**1-5%**
51-57	**>5-10%**
58-61	**>10-15%**
62-65	**>15-20%**
66-70	**>20-30%**
71-74	**>30-40%**
75-78	**>40-50%**
≥79	**>50%**

Circ Cardiovasc Qual Outcomes. 2010;3:25-32

HOW LONG TO KEEP THEM?

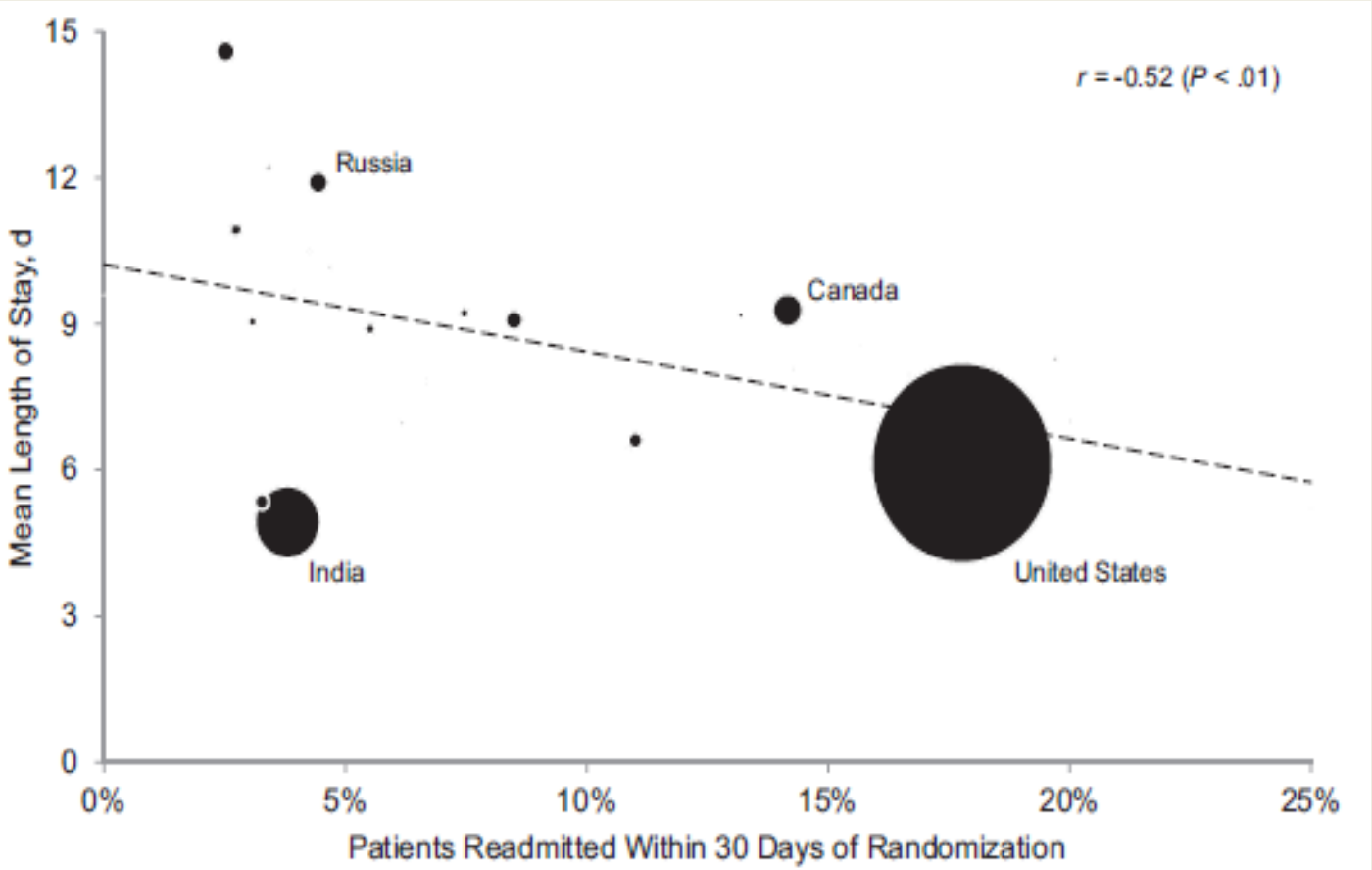
Circulation
Heart Failure

American Heart Association®

Do Countries or Hospitals With Longer Hospital Stays for Acute Heart Failure Have Lower Readmission Rates?: Findings From ASCEND-HF

Zubin J. Eapen, Shelby D. Reed, Yanhong Li, Robb D. Kociol, Paul W. Armstrong, Randall C. Starling, John J. McMurray, Barry M. Massie, Karl Swedberg, Justin A. Ezekowitz, Gregg C. Fonarow, John R. Teerlink, Marco Metra, David J. Whellan, Christopher M. O'Connor, Robert M. Califf and Adrian F. Hernandez

Circ Heart Fail. 2013;6:727-732; originally published online June 14, 2013;



“Let’s get an echo to know the EF”

- It is very difficult to assess cardiac function when HR:130 bpm!
- It is very difficult to interpret very poor echo images
- Right chambers are usually not well visualized
- They have already had WMA and depressed systolic function.

2013 ACCF/AHA Guideline for the Management of Heart Failure

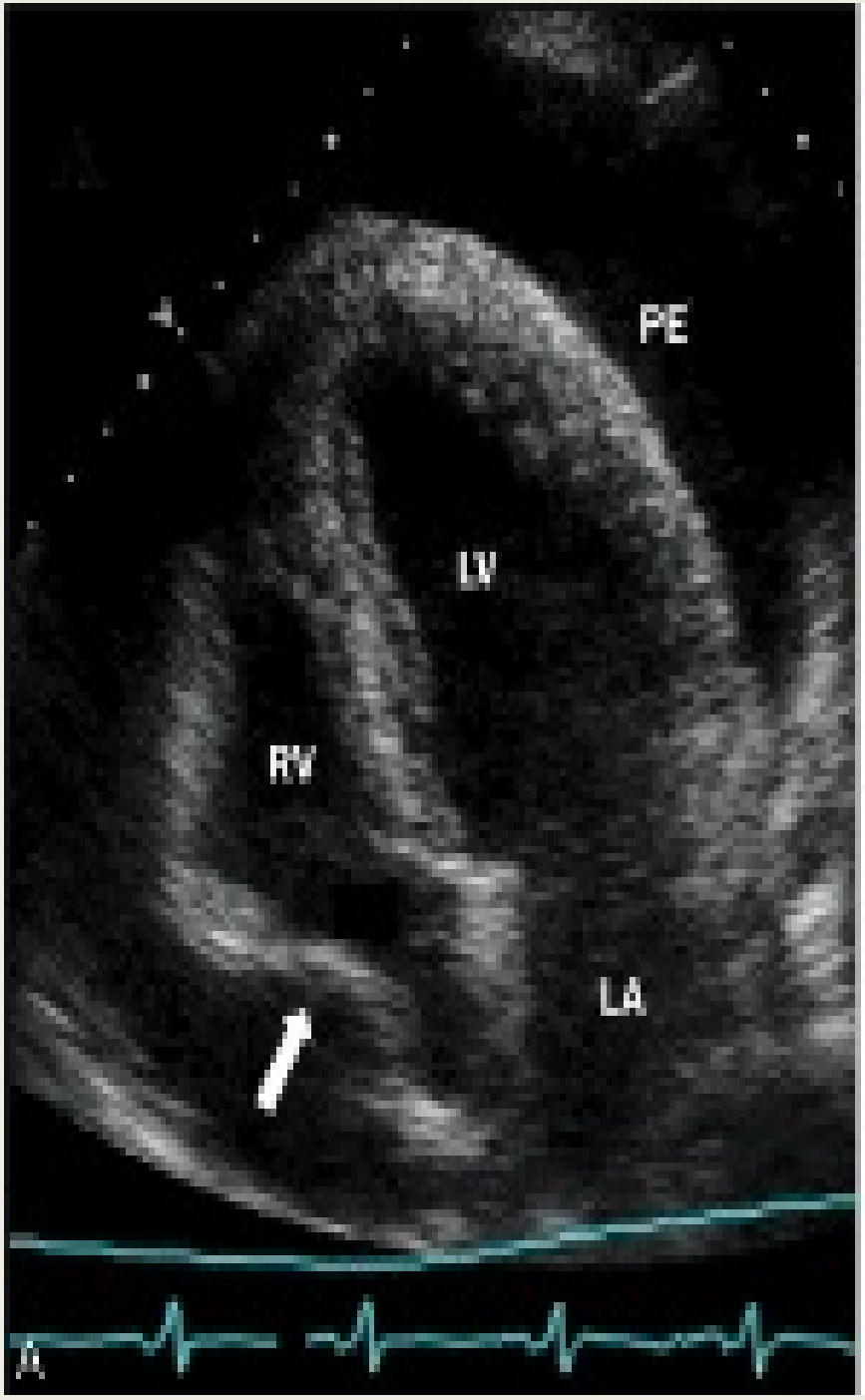
A Report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines

Developed in Collaboration With the American College of Chest Physicians, Heart Rhythm Society and International Society for Heart and Lung Transplantation

Endorsed by the American Association of Cardiovascular and Pulmonary Rehabilitation

Class III: No Benefit

1. **Routine repeat measurement of LV function assessment in the absence of clinical status change or treatment interventions should not be performed.[289,290] *(Level of Evidence: B)***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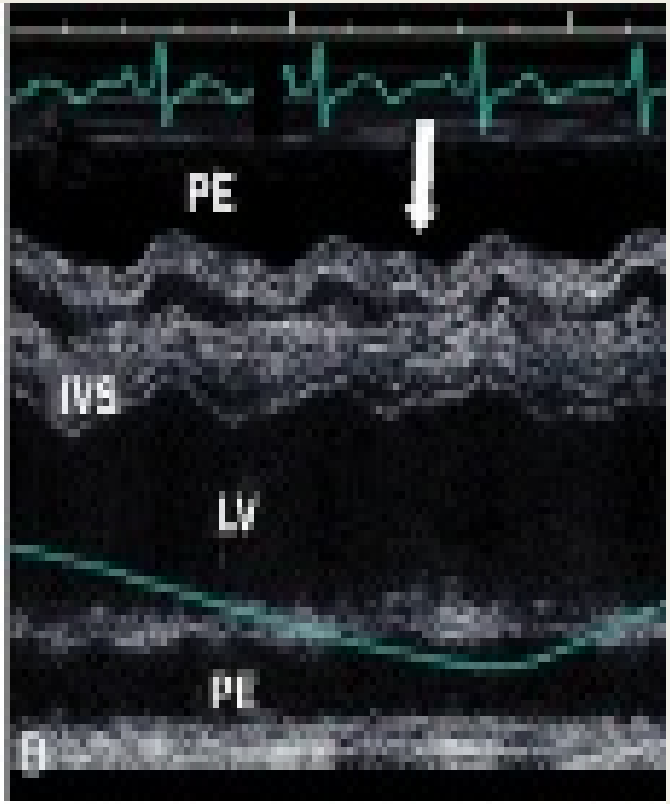
LV
RV
LA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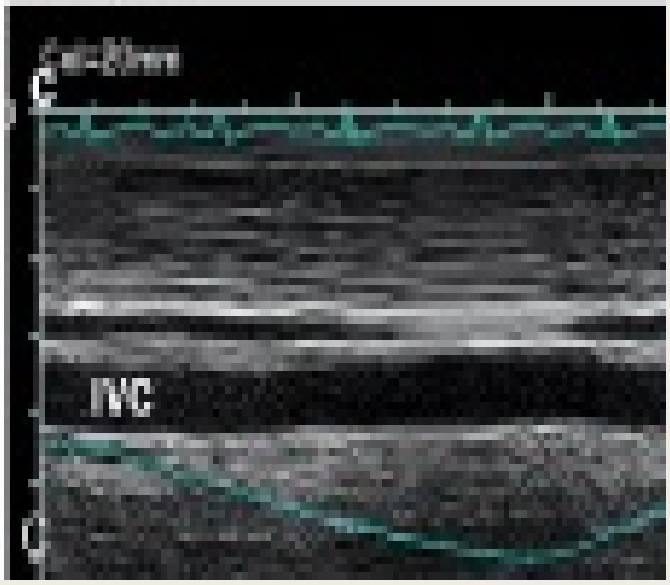
IVS
LV
PE


IVC

WHAT STRATEGY TO USE FOR DIURESIS?

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 MARCH 3, 2011 VOL. 364 NO. 9

Diuretic Strategies in Patients with Acute Decompensated Heart Failure

G. Michael Felker, M.D., M.H.S., Kerry L. Lee, Ph.D., David A. Bull, M.D., Margaret M. Redfield, M.D., Lynne W. Stevenson, M.D., Steven R. Goldsmith, M.D., Martin M. LeWinter, M.D., Anita Deswal, M.D., M.P.H., Jean L. Rouleau, M.D., Elizabeth O. Ofili, M.D., M.P.H., Kevin J. Anstrom, Ph.D., Adrian F. Hernandez, M.D., Steven E. McNulty, M.S., Eric J. Velazquez, M.D., Abdallah G. Kfoury, M.D., Horng H. Chen, M.B., B.Ch., Michael M. Givertz, M.D., Marc J. Semigran, M.D., Bradley A. Bart, M.D., Alice M. Mascette, M.D., Eugene Braunwald, M.D., and Christopher M. O'Connor, M.D., for the NHLBI Heart Failure Clinical Research Network*

N Engl J Med 2011;364:797-805.

End Point	Bolus Every 12 Hr (N=156)	Continuous Infusion (N=152)	P Value	Low Dose (N=151)	High Dose (N=157)	P Value
AUC for dyspnea at 72 hr	4456±1468	4699±1573	0.36	4478±1550	4668±1496	0.04
Freedom from congestion at 72 hr — no./total no. (%)	22/153 (14)	22/144 (15)	0.78	16/143 (11)	28/154 (18)	0.09
Change in weight at 72 hr — lb	–6.8±7.8	–8.1±10.3	0.20	–6.1±9.5	–8.7±8.5	0.01
Net fluid loss at 72 hr — ml	4237±3208	4249±3104	0.89	3575±2635	4899±3479	0.001
Change in NT-proBNP at 72 hr — pg/ml	–1316±4364	–1773±3828	0.44	–1194±4094	–1882±4105	0.06
Worsening or persistent heart failure — no./total no. (%)	38/154 (25)	34/145 (23)	0.78	38/145 (26)	34/154 (22)	0.40
Treatment failure — no./total no. (%)†	59/155 (38)	57/147 (39)	0.88	54/147 (37)	62/155 (40)	0.56
Increase in creatinine of >0.3 mg/dl within 72 hr — no./total no. (%)	27/155 (17)	28/146 (19)	0.64	20/147 (14)	35/154 (23)	0.04
Length of stay in hospital — days			0.97			0.55
Median	5	5		6	5	
Interquartile range	3–9	3–8		4–9	3–8	

“MY PATIENT IS NOT RESPONSIVE TO LASIX”

Drug	Initial Daily Dose(s)	Maximum Total Daily Dose	Duration of Action
Loop diuretics			
Bumetanide	0.5 to 1.0 mg once or twice	10 mg	4 to 6 h
Furosemide	20 to 40 mg once or twice	600 mg	6 to 8 h
Torsemide	10 to 20 mg once	200 mg	12 to 16 h
Thiazide diuretics			
Chlorothiazide	250 to 500 mg once or twice	1000 mg	6 to 12 h
Chlorthalidone	12.5 to 25.0 mg once	100 mg	24 to 72 h
Hydrochlorothiazide	25 mg once or twice	200 mg	6 to 12 h
Indapamide	2.5 mg once	5 mg	36 h
Metolazone	2.5 mg once	20 mg	12 to 24 h
Potassium-sparing diuretics*			
Amiloride	5 mg once	20 mg	24 h
Spironolactone	12.5 to 25.0 mg once	50 mg†	1 to 3 h
Triamterene	50 to 75 mg twice	200 mg	7 to 9 h
Sequential nephron blockade			
Metolazone‡	2.5 to 10.0 mg once plus loop diuretic	N/A	N/A
Hydrochlorothiazide	25 to 100 mg once or twice plus loop diuretic	N/A	N/A
Chlorothiazide (IV)	500 to 1000 mg once plus loop diuretic	N/A	N/A

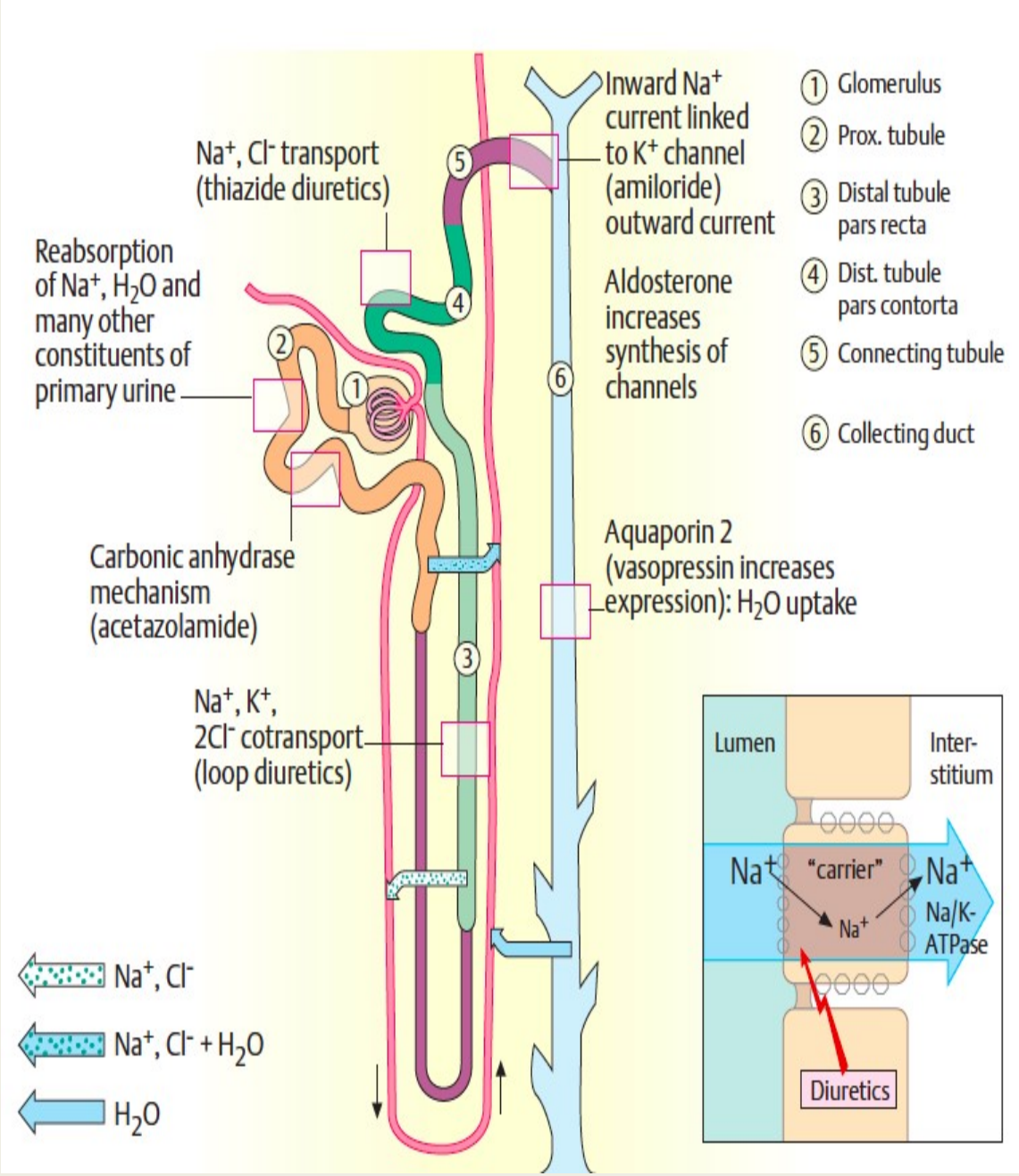
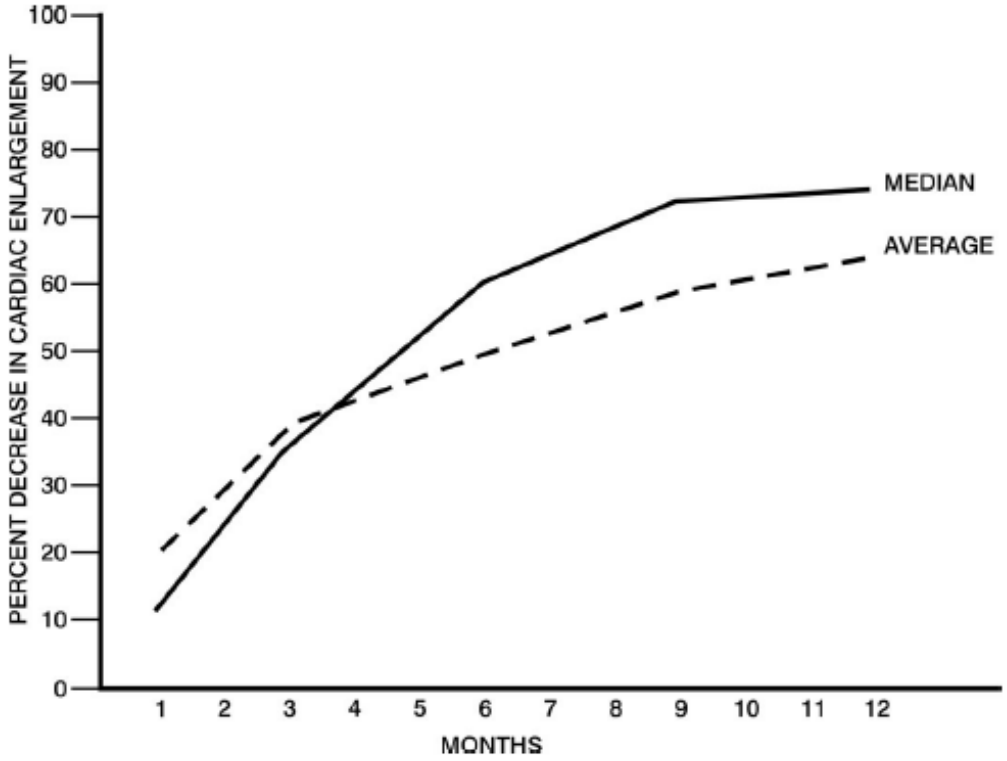

Inward Na+ current linked to K+ channel (amiloride) outward current
Na+, Cl- transport (thiazide diuretics)
Reabsorption of Na+, H2O and many other constituents of primary urine
Aldosterone increases synthesis of channels
1 Glomerulus
2 Prox. tubule
3 Distal tubule pars recta
4 Dist. tubule pars contorta
5 Connecting tubule
6 Collecting duct
Carbonic anhydrase mechanism (acetazolamide)
Aquaporin 2 (vasopressin increases expression): H2O uptake
Na+, K+, 2Cl- cotransport (loop diuretics)
Na+, Cl-
Na+, Cl- + H2O
H2O
Lumen
Inter-stitium
Na+
"carrier"
Na+
Na+
Na/K-ATPase
Diuretics

FIGURE 2. Percent reduction in radiographic heart size found in response to prolonged strict bed rest as reported by Burch et al for patients having a dilated cardiomyopathy and who where no longer responsive to digitalis and mercurial diuretic. Reprinted with permission from Burch GE, Walsh JJ, Black WC. Value of prolonged bed rest in management of cardiomegaly. JAMA 1963;183:81–87.



“I MAXED OUT THE DOSES OF ALL DIURETICS, BUT STILL NOT GETTING ENOUGH DECONGESTION…”

DON'T LET IT FAIL!

Thank You!

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