Promoting resiliency and successful outcomes in heart failure: is the failure all in the heart?

Scott L. Hummel, MD, MS
Assistant Professor, University of Michigan
Staff Cardiologist, Ann Arbor VA Health System
University of Utah Center on Aging Research Retreat
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Heart failure: what is it?

- A progressive illness in which the heart does not meet the physiologic demands of the body
- Common symptoms are shortness of breath, fatigue, fluid retention
- Can occur with weakened or normal systolic (pumping) function, denoted by reduced (HFrEF) or preserved (HFpEF) ejection fraction
Heart failure: the current landscape

- Nearly 6 million Americans with heart failure (HF)
- Incidence rising with aging of population, increased comorbidities, survival of other CVD
- 50% 5-year mortality, poor quality of life
- 1 million primary-diagnosis hospitalizations/year in U.S., 20-25% readmitted within 30 days
- By 2030:
  - Prevalence 8 million
  - Direct costs $70B/year

Heidenreich P et al. Circ Heart Fail 6:606; Owan T et al. NEJM 355:251
HF in community-dwelling older adults (Health ABC study)

Mean age 73.6, 8.8% developed HF over median 7.1 years (13.6/1000 pt-years)

47% died after median 2.1 year follow-up 46.3 admissions/100 patient-years

Kalogeropoulos et al. Archives Int Med 169:708
A cardiologist’s view of heart failure

“If we can just fix the heart, this patient will do fine…”
Justification for this viewpoint

Incremental Reduction in Risk of Death Associated With Use of Guideline-Recommended Therapies in Patients With Heart Failure: A Nested Case-Control Analysis of IMPROVE HF

Gregg C. Fonarow, Nancy M. Albert, Anne B. Curtis, Mihai Gheorghiade, Yang Liu, Mandeep R. Mehra, Christopher M. O’Connor, Dwight Reynolds, Mary N. Walsh and Clyde W. Yancy

Fonarow GC et al. JAHA 2012
Mortality risk modeling in octogenarians with heart failure

Figure 1. Kaplan–Meier analysis comparing observed survival (blue line) to predicted survival (pink line) including 95% confidence intervals (shaded areas) by the Seattle Heart Failure Model in all patients ≥80 years of age followed in an ambulatory tertiary care heart failure clinic from January 2002 through March 2010.

Benbarkat et al. Am J Cardiol 2012;110:1663
How do patients with heart failure die?

Figure 1. Causes of Death by Ejection Fraction
Hospitals Face Pressure to Avert Readmissions

How well do the experts do?

- Heart transplant vs. non-transplant centers, risk-standardized outcomes in Medicare patients ≥ 65
- 30-day mortality: 10.6% vs. 11.5%, p < 0.001
- 30-day all-cause readmission: 23.6% vs. 23.8%, p = 0.55

Hummel SL et al. Circ Heart Fail 2010
How good are we at assessing risk?

LACE Index Scoring Tool for Risk Assessment of Hospital Readmission

Step 1. Length of Stay
Length of stay (including day of admission and discharge): ________ days

<table>
<thead>
<tr>
<th>Length of stay (days)</th>
<th>Score (circle as appropriate)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4-6</td>
<td>4</td>
</tr>
<tr>
<td>7-13</td>
<td>5</td>
</tr>
<tr>
<td>14 or more</td>
<td>7</td>
</tr>
</tbody>
</table>

Step 2. Acuteness of Admission
Was the patient admitted to hospital via the emergency department?
If yes, enter “3” in Box A, otherwise enter “0” in Box A

Step 3. Comorbidities

<table>
<thead>
<tr>
<th>Condition (definitions and notes on reverse)</th>
<th>Score (circle as appropriate)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Previous myocardial infarction</td>
<td>+1</td>
</tr>
<tr>
<td>Cerebrovascular disease</td>
<td>+1</td>
</tr>
<tr>
<td>Peripheral vascular disease</td>
<td>+1</td>
</tr>
<tr>
<td>Diabetes without complications</td>
<td>+1</td>
</tr>
<tr>
<td>Congestive heart failure</td>
<td>+2</td>
</tr>
<tr>
<td>Diabetes with and organ damage</td>
<td>+2</td>
</tr>
<tr>
<td>Chronic pulmonary disease</td>
<td>+2</td>
</tr>
<tr>
<td>Malignant or renal disease</td>
<td>+2</td>
</tr>
<tr>
<td>Any tumor (including lymphoma or leukemia)</td>
<td>+2</td>
</tr>
<tr>
<td>Dementia</td>
<td>+3</td>
</tr>
<tr>
<td>Connective tissue disease</td>
<td>+3</td>
</tr>
<tr>
<td>AIDS</td>
<td>+4</td>
</tr>
<tr>
<td>Moderate or severe liver or renal disease</td>
<td>+4</td>
</tr>
<tr>
<td>Metastatic solid tumor</td>
<td>+6</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
</tr>
</tbody>
</table>

If the TOTAL score is between 0 and 5 enter the score into Box C. If the score is 4 or higher, enter 5 into Box C

Step 4. Emergency department visits
How many times has the patient visited an emergency department in the six months prior to admission (not including the emergency department visit immediately preceding the current admission)?
Enter this number or 4 (whichever is smaller) in Box E

Add numbers in Box L, Box A, Box C, Box E to generate LACE score and enter into box below.

LACE  Score Risk of Readmission: ≥ 10 High Risk
Impact on CMS model of including prior all-cause hospitalizations

Probability histogram for readmission: CMS model only

Readmission probability centered at 0.24

C-statistic=0.61

Probability histogram: CMS model + prior hospitalization

Most patients shifted to either low or high readmission probability

C-statistic=0.74

• How many times have you been in the hospital in the past 1 year?" (0, 1, ≥ 2)
• This variable clearly separates patients into high or low risk categories
• What are the unmeasured risk factors?

Why are heart failure patients hospitalized?

• OPTIMIZE-HF chart review
  – Pneumonia 15%
  – Ischemia 15%
  – Arrhythmia 14%
  – Uncontrolled HTN 11%
  – Worsening renal function 7%
  – Nonadherence to meds 9%
  – Nonadherence to diet 5%

• If you ask the patient or family...
  – 25-64% related to nonadherence

Fonarow et al. Arch Int Med 2008; Ather et al. JACC 2012
What works for all-cause readmissions?


1 hour of discharge education

Table 3. Rates of Mortality, Readmission, and Mortality or Readmission at 30 Days by Quartile of Hospital Rate of Early Follow-up

<table>
<thead>
<tr>
<th>Variable</th>
<th>1 (&lt;32.4)</th>
<th>2 (32.4-37.9)</th>
<th>3 (38.3-44.5)</th>
<th>4 (&gt;44.5)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of patients</td>
<td>7081</td>
<td>6862</td>
<td>7612</td>
<td>6581</td>
<td></td>
</tr>
<tr>
<td>Event, 30 d</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mortality a</td>
<td>353 (5.0)</td>
<td>417 (4.8)</td>
<td>352 (4.5)</td>
<td>297 (4.5)</td>
<td>.44</td>
</tr>
<tr>
<td>Readmission b</td>
<td>1658 (23.3)</td>
<td>1787 (20.5)</td>
<td>1606 (20.5)</td>
<td>1377 (20.9)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Mortality or readmission a</td>
<td>1849 (26.1)</td>
<td>2015 (23.3)</td>
<td>1813 (23.2)</td>
<td>1544 (23.5)</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

Nurse-directed multidisciplinary care
Intensive HF and dietary education
Medication reconciliation
Transitional care planning
Home care services follow-up
Reality testing for cardiologists

“If we can just fix the heart, this patient will do fine…”

“It was the best of times, it was the worst of times, it was the age of wisdom, it was the age of foolishness…”
Comorbidity, Disability Burden, and Polypharmacy in HF patients


Table 3: Trends in Disability and Impairment among Patients with Heart Failure

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobility disabled&lt;sup&gt;a&lt;/sup&gt;</td>
<td>52.6 (3.2)</td>
<td>57.6 (4.2)</td>
<td>56.9 (2.8)</td>
<td>4.3 (-4.1 to 12.7)</td>
<td>.31</td>
</tr>
<tr>
<td>Activities of daily living disabled&lt;sup&gt;a&lt;/sup&gt;</td>
<td>12.5 (1.9)</td>
<td>13.8 (2.1)</td>
<td>11.1 (1.5)</td>
<td>-1.4 (-6.2 to 3.4)</td>
<td>.57</td>
</tr>
<tr>
<td>Vision impaired&lt;sup&gt;a&lt;/sup&gt;</td>
<td>11.8 (1.7)</td>
<td>11.1 (2.8)</td>
<td>11.7 (1.8)</td>
<td>-0.1 (-4.9 to 4.7)</td>
<td>.97</td>
</tr>
</tbody>
</table>

Table 4: Trends in Prescription Medication Use among Patients with Heart Failure

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of prescription medications</td>
<td>4.1 (0.2)</td>
<td>5.1 (0.3)</td>
<td>6.4 (0.2)</td>
<td>2.4 (1.8 to 2.9)</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

Figure: Trends in number of comorbid chronic conditions among patients with heart failure.
Comprehensive geriatric assessment and inpatient HF mortality

N = 581, mean age 86%, acute geriatric unit admission for decompensated HF

Table I. Scoring of the CGA scale

<table>
<thead>
<tr>
<th>Variable</th>
<th>Range</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependency on ADL (Katz index)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Katz A (dependence in none or 1 ADL)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Katz B-C (dependence in 1 or 2 ADL)</td>
<td>1-2</td>
<td>1</td>
</tr>
<tr>
<td>Katz D-G (dependence in ≥3 ADL)</td>
<td>≥3</td>
<td>2</td>
</tr>
<tr>
<td>Mobility dependence (5-item qualitative scale)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical activity carried out without help</td>
<td>0-1</td>
<td>0</td>
</tr>
<tr>
<td>Requires a stick, person, walking frame,</td>
<td>2-4</td>
<td>1</td>
</tr>
<tr>
<td>or wheel chair</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bed bound</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Charlson comorbidity score</td>
<td>0-1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>2-4</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>≥5</td>
<td>2</td>
</tr>
<tr>
<td>Previous cognitive impairment</td>
<td>No</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
<td>2</td>
</tr>
<tr>
<td>No. of medications on hospital admission</td>
<td>0-3</td>
<td>0</td>
</tr>
<tr>
<td>(prescribed and over the counter)</td>
<td>4-7</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>≥8</td>
<td>2</td>
</tr>
</tbody>
</table>

Mortality by CGA quartile:
- Q1 (0-2 points) 1.1%
- Q2 (3-4 points) 5.3%
- Q3 (5-6 points) 9%
- Q4 (7-10 points) 12.8%

C-statistic of model 0.86

Table III. Variables associated with hospital mortality in multivariate analysis

<table>
<thead>
<tr>
<th>Variable</th>
<th>Odds ratio</th>
<th>95% CI</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>NYHA functional class</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NYHA III (vs I-II)</td>
<td>4.1</td>
<td>1.5-10.8</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>NYHA IV (vs I-II)</td>
<td>19.6</td>
<td>6.3-60.9</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>CGA score (per point)</td>
<td>1.2</td>
<td>1.0-1.4</td>
<td>.04</td>
</tr>
<tr>
<td>Pulmonary edema on chest x-ray</td>
<td>3.0</td>
<td>1.3-6.6</td>
<td>.005</td>
</tr>
<tr>
<td>Renal failure</td>
<td>2.8</td>
<td>1.2-6.2</td>
<td>.011</td>
</tr>
</tbody>
</table>

Rodriguez-Pascual et al. Amer Heart J 2012
Social support, daily living activity

4-question social network survey:
1) Are you married?
2) Do you live with another person?
3) Do you have daily in-person or telephone contact with family?
4) Are you home alone < 2 hours/day?

High social network: all 4 items
Moderate network: 3 items
Low network: ≤ 2 items

- N=433 Spanish ADHF patients ≥ 65
- Moderate or low network nearly doubled risk of rehospitalization
- Independent of biological risk factors, comorbidities, Katz index
- Comparable risk to previous hospitalizations
Cognitive screening in hospitalized heart failure patients

Patel A et al. Circ Heart Fail 8:8
The importance of delirium

Common risk factors:
- Cognitive impairment
- Age > 65, age > 80
- Severe illness
- Infection
- Visual/hearing impairment
- Electrolyte abnormalities
- Poor mobility
- Sleep deprivation

Figure 1. Acute decompensated heart failure readmission risk at 30 and 90 days in patients with heart failure stratified by presence (gray bars) or absence (black bars) of delirium.

Mark Supiano @Aging_MD

So pleased to offer this delirium prevention program for @UofUHealth patients. @ElderLifeProg @UtahGeriatrics twitter.com/AnnaBeckMD/stat...
Medication nonadherence in HF

40-60% at least partially nonadherent
Increases clinical events
No universally accepted screening method for risk

Cognitive/attention deficit
Depression
Multimorbid illness
Complexity of regimen
Poor social support
Recent hospitalization

Davis EM et al. J Manag Care Pharm 2014
Pharmacist involvement in HF

- Increases medication knowledge and adherence
- In many studies, associated with improved functional status and disease-related quality of life
- Tends to be associated with reduced readmission rate, but often not sustained after intervention ends

VA Ann Arbor post-discharge clinic

- Prior to post-discharge clinic, mean time to first follow-up 21-23 days
- Now 14±14 days, 11±6 days in those who attended HF post-discharge clinic and 17±20 in patients who did not (p < .001 for comparison)

Frailty – a geriatric syndrome

- Increased vulnerability to stressors
- Cumulative declines across physiological systems
- Frequently overlaps with sarcopenia
- May have intersecting mechanisms with HF
- Many measures, two basic schools of thought:
  - Disability-based
  - Functionality/strength-based

Frailty in heart failure

Fried frailty index: $\geq 3$ of: unintentional weight loss, low grip strength, exhaustion, slow gait speed, low physical activity

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**Figure 1** Cox proportional hazards regression survival curve by frailty. Adjusted for age, gender, Charlson co-morbidity index, NT-proBNP, NYHA, and the presence of a co-existing acute disease. CI, confidence interval.
Fried frailty model

HF-ACTION study: cardiac rehab

• 2,331 stable outpatients, EF ≤ 35%, age 59
• Randomized to exercise vs. usual care
• Supervised exercise, 36 sessions/3 months
• Key findings
  – Exercise was well-tolerated and safe
  – Patients randomized to exercise:
    • Increased functional capacity
    • Had fewer depressive symptoms
    • Trended toward lower hospitalization rate

O’connor et al. JAMA 2009
REHAB-HF pilot study

• Age ≥ 60, hospitalized for ADHF (n=27)
• 3x/week center-based exercise for 12 weeks post-discharge
• Exercise Rx guided by functional performance in 4 domains
• Outcomes: feasibility, safety, SPPB, 6-minute walk distance

Ongoing REHAB-HF study: NCT02196038
N= 360 patients at 3 sites
Primary: SPPB; Secondary: rehospitalization

Reeves et al. JCHF 2017 (in press); clinicaltrials.gov
Concurrent malnutrition and frailty

Hospitalized older adults

- 90% at risk of malnutrition frail or pre-frail
- 46% of frail at risk of malnutrition
- 93% of frail at risk of malnutrition or malnourished

Malnutrition and death in HF

Mini-nutritional Assessment (MNA)
- Food intake, weight, mobility
- Neuropsychological problems
- Physiological stress
- Living environment
- Polypharmacy
- Arm and calf circumferences

Nutritional risk index (NRI)
- Simple calculation based on albumin and weight vs. ideal body weight
- Also markedly increases mortality in patients with HF
- Even in advanced HF (ESCAPE study data below)

Lin H et al. Heart Failure Reviews 2016; Adejumo O et al. JHLT 2015
Why can’t my patient eat a healthier diet?

### TABLE 3 Factors Rated* as Having Greatest Effect on Food Intake

<table>
<thead>
<tr>
<th></th>
<th>Heart Failure</th>
<th>Healthy Elders</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount of salt allowed in diet</td>
<td>2.6 (1.6)</td>
<td>2.0 (1.2)</td>
<td>.01</td>
</tr>
<tr>
<td>Not feeling hungry</td>
<td>2.5 (1.4)</td>
<td>1.5 (0.9)</td>
<td>.001</td>
</tr>
<tr>
<td>Feel full after small amount of food</td>
<td>2.6 (1.5)</td>
<td>1.6 (1.0)</td>
<td>.001</td>
</tr>
<tr>
<td>Diet restrictions other than sodium</td>
<td>2.6 (1.3)</td>
<td>1.7 (1.1)</td>
<td>.001</td>
</tr>
<tr>
<td>Number of pills taken per day</td>
<td>2.3 (1.6)</td>
<td>1.7 (1.1)</td>
<td>.005</td>
</tr>
<tr>
<td>Lack of energy to cook food</td>
<td>2.2 (1.4)</td>
<td>1.4 (0.9)</td>
<td>.001</td>
</tr>
<tr>
<td>Limited variety of foods in diet</td>
<td>2.2 (1.3)</td>
<td>1.4 (0.9)</td>
<td>.001</td>
</tr>
<tr>
<td>Feeling nervous</td>
<td>2.2 (1.4)</td>
<td>1.3 (0.7)</td>
<td>.001</td>
</tr>
<tr>
<td>Feeling short of breath</td>
<td>2.2 (1.3)</td>
<td>1.5 (1.0)</td>
<td>.001</td>
</tr>
<tr>
<td>Feeling sad</td>
<td>2.2 (1.4)</td>
<td>1.3 (0.7)</td>
<td>.001</td>
</tr>
<tr>
<td>Feeling nauseated</td>
<td>2.0 (1.4)</td>
<td>1.2 (.71)</td>
<td>.001</td>
</tr>
<tr>
<td>Decreased sense of smell</td>
<td>2.0 (1.3)</td>
<td>1.7 (1.0)</td>
<td>.14</td>
</tr>
<tr>
<td>Decreased sense of taste</td>
<td>2.0 (1.3)</td>
<td>1.8 (1.0)</td>
<td>.18</td>
</tr>
</tbody>
</table>

*Factors were rated on a scale of 1 to 5; 5 indicates greatest effect.

Geriatric OUT-of-hospital RANDOMIZED MEal Trial in Heart Failure (GOURMET-HF)

- **Hypothesis:** In elderly patients following discharge from HF hospitalization, 4 weeks of home-delivered low-sodium DASH diet meals will improve disease-related quality of life (Kansas City Cardiomyopathy Questionnaire)

- **Primary outcome:** KCCQ summary score change from discharge-4 weeks

Wessler J et al. Am Heart J 2015
GOURMET-HF study: baseline

- n=37 patients, age 71±8, 78% male, BMI 31±6 kg/m²
- Block Food Frequency Questionnaire obtained during admission
- Dietary micronutrient deficiency was scored: 1 point for each (of 15) below Dietary Reference Intake (DRI) thresholds
- Excess energy available was calculated as (FFQ-estimated energy intake – DRI-recommended energy intake)
- Sodium and energy intake highly correlated (r=0.95, p<0.001)

Hummel/Maurer (unpublished; abstract ACC 2017)
Cardiologist’s view of geriatric heart failure

Malnutrition
Poor Social Support

Polypharmacy
Geriatric cardiologist’s view of heart failure

- Malnutrition
- Polypharmacy
- Frailty, Mobility Limitations, Disability
- Poor Social Support
- Multi-morbidity, overall symptom burden
- Cognitive impairment