Remote patient management after discharge of hospitalized heart failure patients: the Better Effectiveness After Transition - Heart Failure (BEAT-HF) study

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Background

• It remains unclear if telemonitoring approaches provide benefits for heart failure (HF) patients following hospitalization.
  – Systematic reviews of smaller studies show readmission and mortality reductions
  – Recent large RCTs (e.g., Tele-HF, TIM-HF) showed no benefit for readmission or mortality

• Multiple potential explanations for recent RCTs lack of benefit
  – Adherence concerns: newer remote monitoring approaches and engaging patients prior to discharge could improve adherence
  – Telemonitoring approach: pairing remote monitoring with a telephone-based nurse care manager using scheduled contacts similar to in-person care transition programs could improve outcomes
Study Objective

• Evaluate the effectiveness of a care transition intervention using remote patient monitoring among a broad population of older adults hospitalized with HF

• Primary outcome: 180-day all-cause readmission

• Secondary outcomes: 30-day all-cause readmission, 30-day mortality, and 180-day mortality
Study Methods: Intervention

• Pre-discharge HF education
  – Low health literacy self-management using “teach-back” techniques
  – Use of telemonitoring equipment

• Regularly scheduled telephone coaching
  – 9 telephone health coaching calls by RN starting 2-3 days after discharge
  – Weekly calls for first month, monthly calls through 6 months

• Telemonitoring: weight, blood pressure, heart rate, symptoms
  – Daily use of Bluetooth-enabled weight scale and a blood pressure/heart rate monitor integrated with text device
  – Data transferred via cellular bandwidth, daily review by RN
  – Patients called if exceeded predetermined threshold parameters
  – Patient’s HF providers notified for significant symptoms, if necessary sent to ED
Study Methods: Evaluation

• Prospective RCT: intervention vs. usual care
  – Conducted at six academic health systems in California

• Study population: Individuals age 50 or older hospitalized and receiving active treatment for decompensated HF
  – Defined as HF with initiation of or an increase in diuretic treatment
  – Exclusions: could not fully participate in intervention, expected intensive post-discharge care, HF expected to improve after procedure
Study Methods: Analyses

• Intention to treat framework
  – 80% power to detect a 28% relative reduction in primary outcome

• Unadjusted and adjusted survival analyses and multivariable logistic regressions
  – Adjusted models controlled for age, gender, race/ethnicity, insurance, income, social isolation, comorbidities, year and quarter of enrollment, with enrollment site as random effects

• Post-hoc analyses on adherence to intervention
  – Adherence evaluated based on total days alive
  – Additionally adjusted for education and baseline scores for self confidence and self maintenance in managing HF
Enrollment
Assessed for eligibility (n=30,844)
- Excluded (n=29,407)
  - Not meeting inclusion criteria (n=28,476)
  - Declined to participate (n=550)
  - Discharged before approach (n=375)
  - Expired before approach (n=8)
Randomized (n=1,437)

Allocation
Allocated to control (n=722)
- Received allocated intervention (n=722)
- Did not receive allocated intervention (n=0)
Allocated to intervention (n=715)
- Received allocated intervention (n=715)
- Did not receive allocated intervention (n=0)

Follow-Up
Discontinued intervention (n=307)
- Expired (n=106)
- Withdrew (full withdrawal, n=13)
- Lost to survey follow-up (n=188) (includes withdrawal from survey and unreachable)
Discontinued intervention (n=306)
- Expired (n=92)
- Withdrew (full withdrawal, n=20)
- Withdrew (withdrawal from intervention, n=87)
- Lost to survey follow-up (n=107) (includes withdrawal from survey and unreachable)

Analysis
Analyzed (n=722)
Analyzed (n=715)
# Results

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Intervention (N = 715)</th>
<th>Usual Care (N = 722)</th>
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</thead>
<tbody>
<tr>
<td>Median Age (IQR)</td>
<td>73 (62 - 84)</td>
<td>74 (63 - 82)</td>
</tr>
<tr>
<td>Female</td>
<td>45.40 (41.57 - 49.23)</td>
<td>45.70 (41.90 - 49.50)</td>
</tr>
<tr>
<td>African American</td>
<td>22.09 (18.89 - 25.28)</td>
<td>22.32 (19.14 - 25.50)</td>
</tr>
<tr>
<td>Hispanic/Latino</td>
<td>11.35 (8.91 - 13.79)</td>
<td>10.41 (8.08 - 12.74)</td>
</tr>
<tr>
<td>Caucasian/White</td>
<td>54.60 (50.77 - 58.43)</td>
<td>54.90 (51.10 - 58.70)</td>
</tr>
<tr>
<td>Asian/Pacific Islander/Other</td>
<td>11.96 (9.47 - 14.46)</td>
<td>12.37 (9.86 - 14.88)</td>
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<tr>
<td>HF Severity</td>
<td></td>
<td></td>
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<tr>
<td>NYHA Class I</td>
<td>0.17 (-0.16 - 0.50)</td>
<td>0.69 (0.01 - 1.36)</td>
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<tr>
<td>NYHA Class II</td>
<td>23.44 (20.02 - 26.86)</td>
<td>25.82 (22.25 - 29.39)</td>
</tr>
<tr>
<td>NYHA Class III</td>
<td>65.60 (61.76 - 69.43)</td>
<td>63.86 (59.94 - 67.77)</td>
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<tr>
<td>NYHA Class IV</td>
<td>10.79 (8.29 - 13.30)</td>
<td>9.64 (7.23 - 12.05)</td>
</tr>
</tbody>
</table>
Results

• 1,437 individuals enrolled and randomized between October 2011 and September 2013
  – 715 intervention, 722 usual care
  – No significant participant characteristics differences between groups
  – Median age 73 years; 45.6% were female, 22.2% were African American, 61.2% New York Heart Association (NYHA) III or IV

• Intervention
  – 82.7% of participants used the telemonitoring equipment
    • At 180 days, >50% calls: 68.0%, >50% telemonitoring 51.7%
  – 221,211 remote observations, 18,531 exceeded threshold parameters
    • median of 22 (interquartile range, IQR, 8 to 48) per participant
  – 3,700 scheduled health coaching calls completed
    • median of 6 (IQR, 3 to 8) per participant
Results

Hazard ratio for 30-day readmission with intervention 1.03 (95%CI 0.83 – 1.29)
Adjusted hazard ratio for 30-day readmission with intervention 1.01 (95%CI 0.80 – 1.28)

Hazard ratio for 180-day readmission with intervention 1.03 (95%CI 0.89 – 1.19)
Adjusted hazard ratio for 180-day readmission with intervention 1.03 (95%CI 0.88 – 1.20)
Results

Hazard ratio for 30-day mortality with intervention 0.61 (95%CI 0.37 – 1.02)
Adjusted hazard ratio for 30-day mortality with intervention 0.53 (95%CI 0.31 – 0.93)

Hazard ratio for 180-day mortality with intervention 0.88 (95%CI 0.67 – 1.15)
Adjusted hazard ratio for 180-day mortality with intervention 0.85 (95%CI 0.64 – 1.13)
## Results

<table>
<thead>
<tr>
<th></th>
<th>Proportion of calls completed</th>
<th>Proportion of days monitored</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Overall</td>
<td>&lt;50%</td>
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<tr>
<td><strong>Readmit</strong></td>
<td></td>
<td></td>
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<tr>
<td>30 day</td>
<td>23.3</td>
<td>34.7</td>
</tr>
<tr>
<td>180 day</td>
<td>52.2</td>
<td>54.0</td>
</tr>
<tr>
<td><strong>Mortality</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30 day</td>
<td>3.4</td>
<td>8.7</td>
</tr>
<tr>
<td>180 day</td>
<td>14.0</td>
<td>26.0</td>
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***p≤0.001
Limitations

• Study sites are all California academic medical centers
  – 3/6 sites were safety net hospitals, broad patient eligibility criteria increases generalizability.

• Use of other types of personnel instead of registered nurses potentially could have affected study outcomes.

• Intervention not directly integrated with the physician practices caring for the patients
  – Increasingly possible with advances in electronic health records.

• Rapid technological change with remote patient monitoring
  – Newer approaches, such as implantable devices or tablets and unobtrusive sensors could increase adherence or provide better information to identify problems following discharge.
Conclusions

• The BEAT-HF study found that a combination of remote patient monitoring with care transition management did not reduce 180 day all cause readmission after HF hospitalization
  – Hospitalizations in the first 30 days and 180 day mortality were also not reduced with the intervention

• Mortality in the first 30 days was reduced significantly in prespecified multivariable adjusted analyses
  – Case review indicates due to in-hospital death differences after randomization, less likely to be due to the intervention
Conclusions

• Individuals with higher adherence may experience fewer readmissions and deaths than those with lower levels of adherence
  – Further studies specifically designed to evaluate effects of different levels of adherence are needed to confirm these findings as these were from post-hoc analyses

• BEAT-HF designed to determine the effectiveness of the combined care transition and remote patient monitoring intervention using a broad population of high-risk and diverse patients hospitalized with HF that would be consistent with actual practice
  – Increases generalizability