Tinker Tailor Doctor Spy: Modern Espionage in Heart Failure Care

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Disclosures

• Advisory board
  • Celladon
Heart Failure Burden

• > 5 million Americans with heart failure (HF)
• >1 million hospital discharges annually
  • Hospitalization >50% of the cost of HF care
• 30 day readmission rate for HF is ~25% nationally
HF is a Chronic Disease
**Congestive Heart Failure Self-Management Plan**

**EVERY DAY:**
- ☐ Weigh yourself in the morning
- ☐ Take your medications
- ☐ Eat low salt food
- ☐ Balance activity with rest periods

<table>
<thead>
<tr>
<th>Green Flags — All Clear</th>
<th>What this means ...</th>
</tr>
</thead>
<tbody>
<tr>
<td>If you have:</td>
<td></td>
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<tr>
<td>• No shortness of breath</td>
<td>• Your symptoms are under control.</td>
</tr>
<tr>
<td>• Weight gain less than 2 pounds (although a 1-2 pound gain may occur some days)</td>
<td>• Continue to take your medications as ordered.</td>
</tr>
<tr>
<td>• No swelling of your feet, ankles, legs or stomach</td>
<td>• Follow healthy eating habits.</td>
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<tr>
<td>• No chest pain</td>
<td>• Keep all physician appointments.</td>
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<tr>
<td>• Ability to do usual activities</td>
<td></td>
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</tbody>
</table>

*Keep up the good work!*

<table>
<thead>
<tr>
<th>Yellow Flags — Caution</th>
<th>What this means ...</th>
</tr>
</thead>
<tbody>
<tr>
<td>If you have any of the following:</td>
<td>• Your symptoms may indicate that you need an adjustment of our medications.</td>
</tr>
<tr>
<td>• A weight gain of 2–3 pounds in 2–3 days or 4–5 pounds in a week</td>
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<tr>
<td>• Shortness of breath</td>
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<tr>
<td>• Swelling of your feet, ankles, legs or stomach</td>
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<tr>
<td>• Fatigue or lack of energy</td>
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<tr>
<td>• Dry hacking cough</td>
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<td>• Dizziness</td>
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<td>• An uneasy feeling—you know something is not right</td>
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<tr>
<td>• Difficulty breathing when lying down or you sleep sitting up with extra pillows</td>
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<tr>
<td>• Chest pain or heaviness</td>
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</tbody>
</table>

If you notice a Yellow Flag, work closely with your healthcare team.

<table>
<thead>
<tr>
<th>Red Flags — Stop and Think</th>
<th>What this means ...</th>
</tr>
</thead>
<tbody>
<tr>
<td>If you:</td>
<td>You need to be evaluated by a health care professional immediately.</td>
</tr>
<tr>
<td>• Are struggling to breathe or have unrelieved shortness of breath while sitting still</td>
<td></td>
</tr>
<tr>
<td>• Have chest pain not relieved or recurs after taking 3 nitro tablets</td>
<td></td>
</tr>
<tr>
<td>• Have confusion or can’t think clearly</td>
<td></td>
</tr>
</tbody>
</table>

Follow these instructions:

**CALL 9-1-1**

If possible, notify your healthcare provider’s office:

**Physician:**

**Number:**

**SYMPTOM DRIVEN CARE PLAN**
HF is a Chronic Disease

- Hospitalization
- MD Visit
- Phone Call
- MD Visit
- Phone Call
- Phone Call
- MD Visit
- Phone Call
- Phone Call
- Phone Call

- Weight log → Phone Call → Medication Change
HF is a Chronic Disease
Filling in the gaps?

Meetings held with:

- Discharge planning
- Nurse coordinators
- Managed care CEO
- Lawrence Berkeley lab
- NSA (not really)
Flight of Ideas

- Food and weight logs
- Structured calls
- Home visits
- Nanotechnology to determine sodium content of diet
- Nanny cam in the kitchen

Not there yet

“Illegal”
“Violation of Civil Rights”
Telemonitoring in Patients with Heart Failure

Sarwat I. Chaudhry, M.D., Jennifer A. Mattera, M.P.H., Jeptha P. Curtis, M.D., John A. Spertus, M.D., M.P.H., Jeph Herrin, Ph.D., Zhenqiu Lin, Ph.D., Christopher O. Phillips, M.D., M.P.H., Beth V. Hodshon, M.P.H., J.D., R.N., Lawton S. Cooper, M.D., M.P.H., and Harlan M. Krumholz, M.D.

- Negative trial (no benefit for death or readmission)
- High non-participation rate in the treatment arm (55% at 6 weeks)
META-ANALYSIS

Structured telephone support or telemonitoring programmes for patients with chronic heart failure

CHF-related hospitalisations reduced
• Structured telephone support (RR 0.77, 95% CI 0.68 to 0.87, P < 0.0001)
• Telemonitoring (RR 0.79, 95% CI 0.67 to 0.94, P = 0.008)

Cochrane Database Syst Rev. 2010 Aug 4;(8):
Barriers to Telemonitoring

- **Patient burden**
  - Stand on scale
  - Record data
  - Phone data into call center/RN
  - Equipment reliability

- **Provider burden**
  - Look at data and interpret data
    - “Weight is up 5 pounds, but patient says he feels great.”
    - “Weight is up, but creatinine is up”
  - Noise
  - Liability
  - Patients’ constitutional rights
Will New Devices Facilitate?

- BEAT-HF trial pending
  - Multicenter telemonitoring trial of HF patients
The Future of Telehealth
Heart Failure

- Requires minimal patient participation for data collection
- Easy to use and set up
- Cost-effective
- Provides actionable data
  - Actions that can be done in outpatient setting
- Improves symptoms/quality of life
CardioMEMSTM HF System

PA Pressure Sensor on Catheter Delivery System

Patient Home Electronics Unit

PA Pressure Database

Physician Access Via Secure Website
Sensor Concept

\[ f = \frac{1}{2\pi\sqrt{L \cdot C(P)}} \]

Frequency vs. Pressure

Sensor Cross section

Nanometer deflections

Pressure Waveform
Pulmonary Artery Pressure

- Traditionally information obtained invasively using a pulmonary artery catheter. Patients are in the ICU.
Why Use PA Pressure?

Patient Work Flow

• Patient lays on pillow
• Patient presses button to record and transmit PA pressure
Reading

Systolic: 24
Mean: 19
Diastolic: 16
Heart Rate: 81
UCD Work Flow

- NP checks CardioMEMS website at regular intervals
  - May also respond to trigger emails that are sent automatically if thresholds are exceeded
- If trend of PA pressures is deviating from target PA pressure a phone call is made, medications adjusted
- Medication change is documented in the CardioMEMS website
Outcomes: Admissions and QOL

MLWHF Score
Favored the treatment group
Benefits

- Automatic transmission of data to provider
  - Minimal patient burden
- Good physiologic data
  - Actionable early
- Works in patients with systolic (HFrEF) and diastolic (HFpEF) heart failure
Limitations

- Invasive
- Expensive
- Data itself doesn’t reduce readmissions
  - Actions taken in response to the data are important
- Unclear if there will be benefit outside of a structured heart failure clinic population
Summary

- Home monitoring for chronic diseases will be part of the care plan of many patients in the future.
- Quality data on efficacy of most devices is lacking.
- A high quality clinical trial does support the use of invasive, ambulatory pulmonary artery pressures in patients followed by HF clinics:
  - High degree of patient adherence.
  - Reliable biometric data.