PENNSTATE HERSHEY
Milton S. Hershey Medical Center

Variation in daily median respiratory rate identifies patients at higher risk of worsening HF in 30 days

John P. Boehmer, MD [1], Qi An, PhD [2], Yi Zhang, PhD [2], Alex Shih, PhD [2]

[1] Penn State Hershey Medical Center, Hershey, PA
[2] Boston Scientific, St Paul, MN

CRM-159703-AA May 2013

Presenter Disclosure Information

- I have financial relationships to disclose:
  - Employee of:
  - Consultant for: Boston Scientific
  - Stockholder in:
  - Research support from: Boston Scientific
  - Honoraria from:

PENNSTATE HERSHEY
Milton S. Hershey Medical Center

Introduction

- Respiratory distress is common in heart failure (HF) patients and is the primary driver for HF hospitalization.
- Respiratory symptoms such as breathlessness and orthopnea are significantly related to increased mortality and hospitalization.
- Many HF patients have an implantable cardioverter defibrillator (ICD) or cardiac resynchronization therapy defibrillator (CRT-D), which is capable of monitoring respiration via intra-thoracic impedance.
- The Multisensor Chronic Evaluations in Ambulatory Heart Failure Patients (MultiSENSE) study collects respiratory data in HF patients, enabling evaluation of prognostic value of the Respiratory Rate Trend (RRT).

Study Design

- MultiSENSE study is a multi-center, non-randomized, feasibility study to evaluate the ability of multiple sensors to reflect early signs of worsening heart failure
- Up to 990 subjects with existing devices
- Key inclusion criteria:
  - Age 18 or above
  - Currently implanted with a COGNIS CRT-D system
  - NYHA Class II, III or IV within the last 6 months
- Key exclusion criteria:
  - Documented as pacemaker dependent
  - A history of appropriate tachycardia therapy within 1 week prior to enrollment
  - Likely to undergo lead or PG revision
  - Subjects that have received a heart or lung transplant
  - Receiving mechanical circulatory transplant
  - A life expectancy of less than 12 months

PENNSTATE HERSHEY
Milton S. Hershey Medical Center

HF Event Definition

- A HF event is declared when the patient has signs and/or symptoms consistent with congestive HF and
  - receives unscheduled intravenous decongestive therapy that does not involve formal in-patient hospital admission, regardless of the setting,

  or,
  - is admitted for HF and receives an augmented HF regimen with oral or intravenous medications.

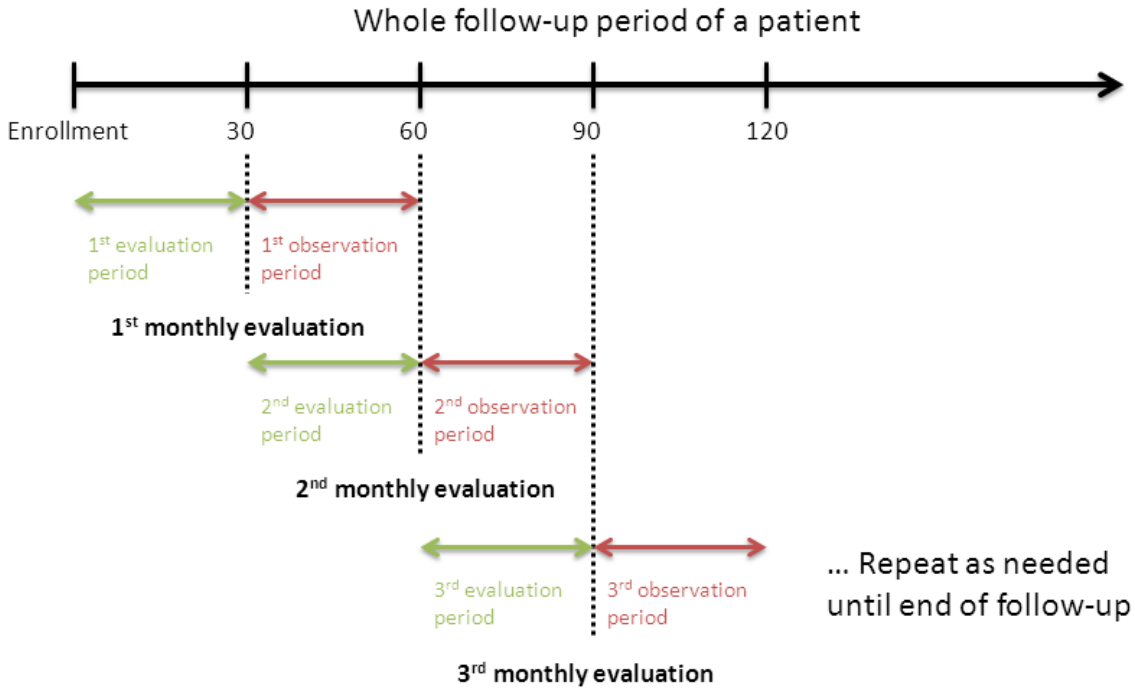
- HF events were reported by centers and adjudicated by an internal employee who is blinded to sensor data and independent of study analysis

Respiratory Rate Trends

- The device is capable of trending daily maximum, median and minimum RR up to a year.
- Daily Maximum Respiratory Rate
  - Maximum of medians of all 10-minute epochs in 24 hours
  - Capture a period of fast breathing, e.g., exercise
- Daily Median Respiratory Rate
  - Median of all valid breaths in 24 hours
- Daily Minimum Respiratory Rate
  - Minimum of medians of all 30-minute epochs in 24 hours
  - Capture a period of slow breathing, e.g., sleeping

Method

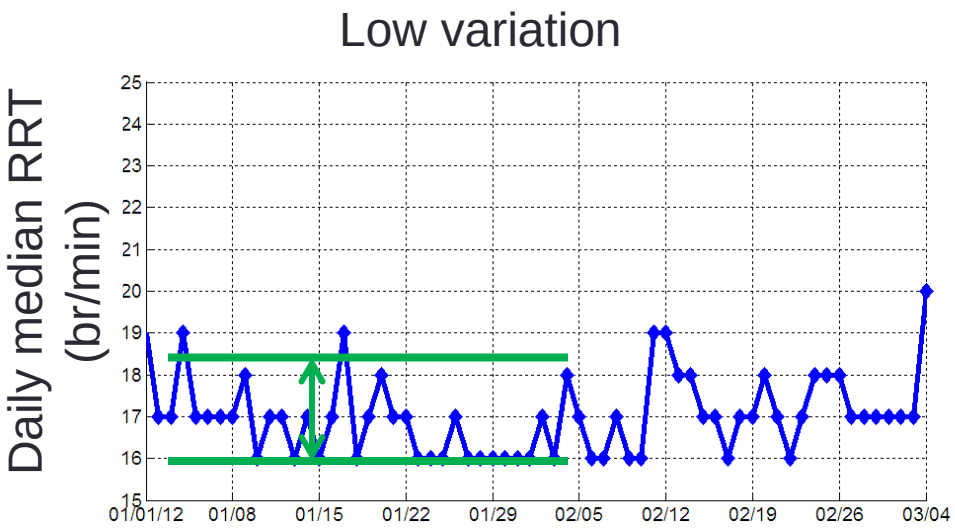
- Daily maximum, median and minimum RRTs were collected using an investigational device based on the COGNIS® CRT-D device
- Differences in respiratory rates between the 10th and 90th percentiles (10%-90% range) were calculated using data in evaluation periods every month

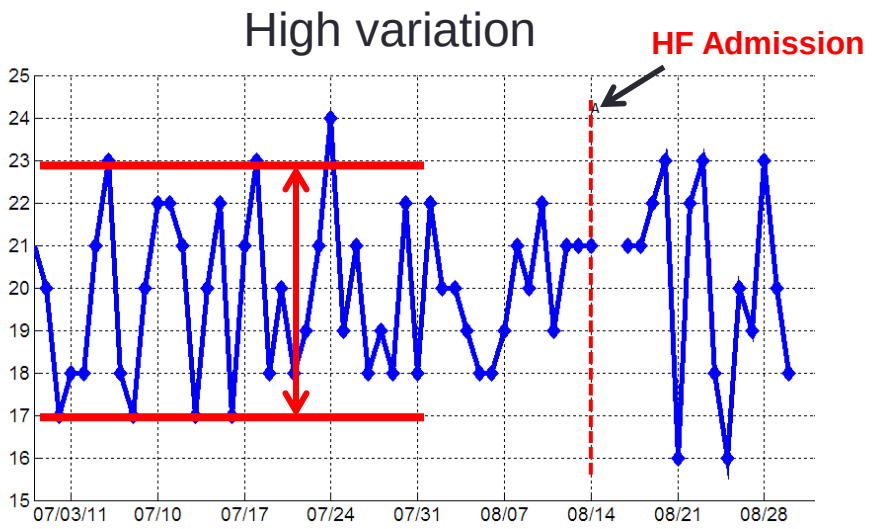


PENNSTATE HERSHEY
Milton S. Hershey Medical Center

Method

- Patients were classified into two groups depending on the RRT range: high variation (range > 4 breaths/minute) and low variation (range ≤ 4)





- Cox proportional hazard model was used to determine the risk and to estimate the hazard ratios (HR, 95% confidence interval (CI)) of a HF event in the next 30-day window in each group

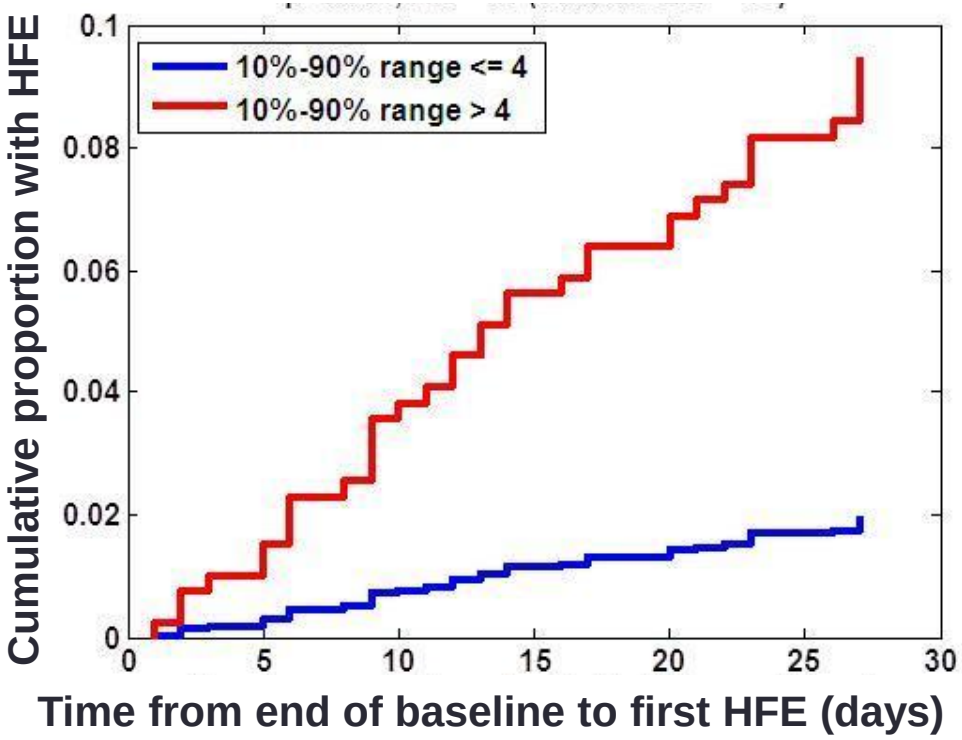
PENNSTATE HERSHEY
Milton S. Hershey Medical Center

Patient Demographics

	ALL (161)	Patients with HF event (31)	Patients without HF event (130)	p-value
Age yrs	66.8	64.7	67.3	0.243
Sex (% Male)	72	76	74	1
NYHA I / II / III /IV %	8/57/33/0	7/38/52/0	9/61/29/0	**0.06**
LVEF	26.7	22.9	27.4	**0.048**
Weight lbs	197	203	195	0.64
Ischemic %	53.2	69	50	0.1
BMI	29.4	30.3	29.3	0.62
DCM %	50.9	52	54	1
MI %	37.9	41	40	1
COPD %	14.9	17	15	0.78
Asthma %	11.2	17	10	0.33
Diabetes %	38.5	52	38	0.21
Renal Dx %	24.2	45	21	**0.017**
Hypertension %	23.7	15	26	0.22
SDB %	15.5	34	12	**0.009**
ACE %	61	45	64	0.065
BB %	92	87	93	0.29
DIUR %	79	93	75	**0.027**

Results

p<0.001, HR = 4.9 (95% CI: 2.2 - 11)



- Significant separation in 30-day risk of HF events was observed between patient groups using daily median RRT
- Patients with a higher 30-day variation in daily median RRT had 4.9-fold increased risk of HF hospitalization within the next month (HR (95% CI): 4.9 (2.2 – 11), p<0.001)
- The risk remained high (HR (95% CI): 5.9 (2.5 – 14), p<0.001) after adjusting for key clinical variables (age, gender, NYHA and LVEF)

PENNSTATE HERSHEY
Milton S. Hershey Medical Center

Conclusion

- Initial data from the MultiSENSE study indicates that patients with higher 30-day variation in daily median RRT have a higher risk of experiencing worsening HF in the next month
- Further evaluation is warranted to determine its clinical value in HF patient management

PENNSTATE HERSHEY
Milton S. Hershey Medical Center