

The Electronic Collection and Presentation of Nocturnal Heart Failure



Cubby L. Gardner¹, Harry B. Burke²

 HEART failure is a major public health problem in the United States (U.S.), with high personal and institutional costs.^{1,2} Reducing heart failure readmissions is a national priority.^{3,4} Most heart failure data is often have difficulty appropriately recognizing and responding to their worsening heart failure.⁵⁻⁸ Heart failure patients experience a high burden of night time symptoms that reduce quality of life and increase their risk of hospitalization.⁸⁻¹³ Unfortunately, there is little systematic literature addressing nocturnal heart failure, despite new findings that a number of physiological functions exhibit circadian rhythmicity, including cardiovascular function¹³ stress,¹⁴ and extracellular fluid shifts.^{redolfi_s_nocturnal_2010} The current approach to the description of heart failure relies on data collected in hospitals and clinics. The problem is that most heart failure patients experience acute exacerbations outside of hospitals and clinics, often at night, at home, when signs and symptoms of disease are not systematically collected. This investigation explores the application of FDA approved technology¹⁵ to acquire information related to the detection of progressive heart failure decompensation at home.¹⁶

Methods: This study assesses the feasibility of using physiologic data acquisition devices and a tablet-based application to collect disease-related data in home-dwelling heart failure patients. After data have been collected, clinicians assess the usability of an electronic display of nocturnal heart failure information derived from the database of physiologic and subjective data. This study asks the following research questions: 1) What is the feasibility of collecting ecologically valid physiological data (heart rate, respiratory rate, blood oxygen saturation, blood pressure, and weight) and subjective data (self-assessment features such as relative shortness of breath, swelling, pain, mood, appetite) by home-dwelling heart failure patients? 2) Can an electronic display of physiological and psychological data be constructed that meaningfully conveys nocturnal heart failure information? 3) What is the patients' and clinicians' assessment of the usability of a system for electronically collecting and presenting nocturnal heart failure information? The setting for this study is Walter Reed National Military Medical Center.

Results: The results of the investigation are pending completion of data collection. We will determine the feasibility of collecting and displaying physiologic and subjective data collected from home-dwelling heart failure patients. Descriptive and summary statistics will be used to characterize the sample and describe feasibility. Patients will evaluate the usability of the data collection devices using the System Usability Scale, which is a 10-item instrument assessing dimensions of usability.¹⁷ Each dimension of usability is assessed on a 5-point Likert scale. Responses are calculated to produce a score from 0 to 100, with 68 representing an average score. Intra-class correlations will be calculated across devices and patients. With the collected data, we will create an electronic display of nocturnal heart failure information. Clinicians will assess usability of the information display with the System Usability Scale.¹⁷ The investigators hypothesize that the mean score will be greater than 68. This hypothesis will be evaluated with the two-tailed Student's t-test. The study is powered (n=37) to detect a 10-point difference at 0.80 power, alpha = 0.05.

Discussion: There is little or no research on the physiological and subjective states of home-dwelling heart failure patients over night. In this study we investigate the feasibility and usability of a system to collect physiologic and subjective information from heart failure patients, in their homes, at night. Then we assess clinicians' perceptions of usability of a system to display information constructed from the collected data. We anticipate that this electronic display will demonstrate above average usability.

Conclusion: This study is a first step toward developing an understanding of nocturnal heart failure in home-dwelling patients and methods to capture reliable physiologic and subjective data. We believe that this system will, in the future provide valuable information for clinicians to improve their management of heart failure patients.

References

1. Disease Control and Prevention, C for. Centers for Disease Control and Prevention. Heart Disease Facts. 2013. URL: <http://www.cdc.gov/heartdisease/facts.htm>.
2. Defense, D of. Department of Defense. 2012 MHS Stakeholders Report. Military Health System. 2013. URL: http://www.health.mil/About_MHS/StakeholdersReport.aspx.
3. ASPA. About the Law. 2013. URL: <http://www.hhs.gov/healthcare/rights/>.

¹Daniel K. Inouye Graduate School of Nursing, Uniformed Services University of the Health Sciences

²School of Medicine, Uniformed Services University of Health Sciences

4. Medicare, C for and Services, M. Readmissions Reduction Program. Acute Inpatient PPS - Readmissions Reduction Program. 2014. URL: <http://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/AcuteInpatientPPS/Readmissions-Reduction-Program.html>.
5. Friedman, MM and Quinn, JR. Heart failure patients' time, symptoms, and actions before a hospital admission. *The Journal of Cardiovascular Nursing* 2008;23:506–512.
6. Patel, H, Shafazand, M, Schaufelberger, M, and Ekman, I. Reasons for seeking acute care in chronic heart failure. *European Journal of Heart Failure* 2007;9:702–708.
7. Riegel, B and Dickson, VV. A situation-specific theory of heart failure self-care. *The Journal of Cardiovascular Nursing* 2008;23:190–196.
8. Redeker, NS, Muench, U, Zucker, MJ, et al. Sleep Disordered Breathing, Daytime Symptoms, and Functional Performance in Stable Heart Failure. *Sleep* 2010;33:551–560.
9. Andrews, LK, Coviello, J, Hurley, E, Rose, L, and Redeker, NS. "I'd eat a bucket of nails if you told me it would help me sleep:" perceptions of insomnia and its treatment in patients with stable heart failure. *Heart & Lung: The Journal of Critical Care* 2013;42:339–345.
10. Redeker, NS. Sleep disturbance in people with heart failure: implications for self-care. *The Journal of Cardiovascular Nursing* 2008;23:231–238.
11. Redeker, NS and Hilkert, R. Sleep and quality of life in stable heart failure. *Journal of Cardiac Failure* 2005;11:700–704.
12. VS, E, CA, W, KA, D, MA, W, and A, H. Sleep disturbance symptoms in patients with heart failure. *AACN clinical issues*, 2003.
13. Mheid, IA, Corrigan, F, Shirazi, F, et al. Circadian Variation in Vascular Function and Regenerative Capacity in Healthy Humans. *Journal of the American Heart Association: Cardiovascular and Cerebrovascular Disease* 2014;3.
14. Wilking, M, Ndiaye, M, Mukhtar, H, and Ahmad, N. Circadian rhythm connections to oxidative stress: implications for human health. *Antioxidants & Redox Signaling* 2013;19:192–208.
15. Corp, ZT. Product information web. 2014. URL: <http://www.zephyranywhere.com/training-systems/defense-solutions/>.
16. AL, B and GC, F. Home monitoring for heart failure management. *J Am Coll Cardiol* 2012;59:97–104.
17. J, B. A quick and dirty usability scale. *Usability evaluation in industry*. 1996.