Continuous Assessment of Daytime Heart Rate Response During Inpatient Rehabilitation

Douglas L. Weeks1,2; Gina L. Sprint3; Alyssa La Fleur4; Jordana Dahmen5; Virgeen Silwill1; Amy Lou Meisen-Vehrs1; and Diane J. Cook6

1St. Luke’s Rehabilitation Institute, Spokane, WA, USA; 2Elson S. Floyd College of Medicine, Washington State University, Spokane, WA, USA; 3Department of Computer Science, Gonzaga University, Spokane, WA; 4Department of Mathematics and Computer Science, Whitworth University, Spokane, WA; 5School of Biological Sciences, Washington State University, Pullman, WA; 6School of Electrical Engineering and Computer Science, Washington State University, Pullman, WA

Background

• To obtain cardiorespiratory benefit, the AHA/ASA recommends exercise at a level of intensity sufficient to maintain heart rate (HR) within a zone equal to 55%-80% of maximal estimated HR (target heart rate or THR) for at least 10 continuous minutes for a total of at least 20 minutes a day, 3-5 days per week.

• Physical activity in inpatient rehabilitation can be used to achieve cardiorespiratory workload within the THR zone.

• It is unclear whether wearable HR sensors can be deployed long-term in inpatient rehabilitation to assess cardiorespiratory training response.

• If feasible, commercially-available sensors offer a low-cost, low-maintenance method for continuously assessing HR response in the inpatient rehabilitation setting.

Research Objectives

• Determine whether HR response to daytime therapy activities in inpatient rehabilitation was maintained within the THR zone for at least 10 continuous minutes for at least 20 minutes daily, 3-5 days per week.

• Determine incidence of excessive HR (EHR>80% of max HR).

• Determine incidence of device-acquired skin breakdown or protocol deviations from staff or patients removing sensors.

Methods

• 15 subjects 44-80 years of age with diagnoses of stroke, cardiac disorders, orthopedic disorders, medically complex conditions, or pulmonary disorder

• Subjects wore wrist-mounted HR sensors day and night throughout the inpatient stay.

• The proportion of subjects meeting THR thresholds for cardiorespiratory benefit and experiencing EHR episodes on a daily basis was quantified.

• Multiple regression techniques predicted THR and EHR outcomes from age, sex, length of stay, and motor function at admission and discharge.

• See Table 1 for patient characteristics.

Results

• 97,800 minutes of HR data were analyzed.

• 60% of subjects met the THR threshold for cardiorespiratory benefit (see Table 1 and Figure 1).

• Age was the single significant predictor of percent of days meeting THR threshold (R=0.58, p=.024).

• 47% of subjects experienced EHR episodes on at least one day (see Table 2 and Figure 2).

• No subjects experienced device-acquired skin breakdown or pressure ulcers, and no protocol deviations occurred from patients or staff removing the sensors.

Conclusions

• This is the initial study to illustrate that collection of HR continuously throughout an inpatient rehabilitation stay via wearable sensors is feasible, acceptable, and safe for assessing heart rate response to daytime therapy activities.

• There were no adverse events reported from long-term use, and no protocol deviations.

• Commercially-available activity monitors with HR-measurement capability have utility for providing long-term objective feedback about HR response in inpatient rehabilitation.

Table 1: Subject characteristics and intensity, duration, and frequency of target heart rate (THR) events during the stay.

Table 2: Frequency and maximal duration of excessive heart rate (EHR) events during the stay.

Figure 1: Percent of Subjects Meeting All THR Recommendations

Figure 2: Percent of Subjects with EHR Episodes