INTRODUCTION
About 100 million people in the U.S. have chronic pain. In addition to the direct experience of pain, people with chronic pain have significant physical and psychological morbidity through its interference with quality of life including sleep, daily activity, and mood[1]. As a result, there is an urgent need for additional therapeutic options. Surface neurostimulation in the form of wearable devices is available as a non-pharmacological option for managing chronic pain. This cross-sectional study evaluated the dose-response of a surface neurostimulator in users with chronic pain.

METHODS
Study Design and Subject Selection. De-identified data were collected from users of a wearable device to treat chronic pain (Quell®, NeuroMetrix, Waltham, MA) during an 8-month period (Jan 2017-Aug 2017). The device semi-continuously stimulates sensory nerves at the upper calf and monitors utilization and biometric parameters. A companion smartphone app collects this data as well as demographics, painful health conditions, pain sites, pain intensity and interference with sleep, activity and mood on an 11-point NRS. Active users were those using the device for ≥3 consecutive calendar months (first period used). Inclusion criteria were active users providing demographic/clinical information and consenting to use of anonymized data for research. Data Analysis. The cross-sectional analysis was conducted on the second month. Typical pain intensity and pain interference were defined as the median value logged during the assessment month. Users were stratified according to days of use (irrespective of amount of use) within the assessment month (low 1-15, intermediate 16-26, high >26). Group differences were evaluated using one-way ANOVA and two-sample t-test. The effect size for baseline, typical, and maximum pain intensity and all three pain interference domains. Small statistically significant differences were found for age, pain duration, number of painful health conditions and number of pain sites. Baseline, Typical, and Maximum Pain Intensity (Table 2). Statistically and clinically significant differences were found for pain interference and all three pain interference domains. Baseline pain intensity was highest (6.0±2.2) for low utilization group and lowest (5.1±2.2) for high utilization group (one-way ANOVA p<0.001, pairwise group differences all significant at p<0.001) and Cohen’s d was 0.46. Baseline and maximum pain intensities were similar for all three groups and had no statistically significant difference between groups (p>0.25).

RESULTS
Demographic and Clinical Characteristics (Table 1). A total of 4058 users met the inclusion criteria (low N=1382, intermediate N=1237, high N=1439). No group differences were found for gender, BMI, or pain intensity. Small statistically significant differences were found for age, pain duration, number of painful health conditions and number of pain sites. Baseline, Typical, and Maximum Pain Intensity (Table 2). Statistically and clinically significant differences were found for pain intensity and all three pain interference domains. Baseline pain intensity was highest (6.0±2.2) for low utilization group and lowest (5.1±2.2) for high utilization group (one-way ANOVA p<0.001, pairwise group differences all significant at p<0.001) and Cohen’s d was 0.46. Baseline and maximum pain intensities were similar for all three groups and had no statistically significant difference between groups (p>0.25).

CONCLUSIONS
High versus low device utilization (based on days of use) was associated with about a 1-point pain intensity and pain interference decrease. This result suggests the possibility of a dose-response relationship between utilization and reduction in pain intensity and pain interference with sleep, activity and mood. Optimal reduction in pain interference is most likely achieved with daily device use.