Introduction
Sleep is a basic human need, and plays an important role in homeostasis of multiple organ systems. Critical illness or postsurgical stress can disrupt normal sleep-wake patterns in healthy children, decreasing the amount of sleep that occurs during the nighttime hours. Additionally, children with neuromuscular disease such as cerebral palsy (CP) commonly undergo orthopedic procedures and are known to have baseline disturbances in sleep-wake patterns due to intrinsic and extrinsic factors.

Objectives
The objective of this study is to examine associations between intraoperative factors and alterations in daytime activity ratios in children undergoing major orthopedic surgery using continuous accelerometry.

Materials and Methods
• Prospective, observational study of pediatric patients ages 2-18 who had major orthopedic surgery requiring PICU admission at a large tertiary hospital was conducted.
• On post-operative day 1, actigraphy monitoring was initiated and continued through to hospital discharge.
• Actigraphy watches provide a non-invasive, continuous method of obtaining accelerometry data to quantify activity.
• The primary outcome measure was the daytime activity ratio (daytime activity/24 hr total activity) while in the PICU.
• Daytime activity was calculated as total activity counts between 7 am-7 pm.
• Independent variables collected included demographics, anesthesia and surgical time, type of anesthetic (inhalational vs. TIVA), total intraoperative morphine and midazolam equivalents, extubation in the OR (yes/no), and steroid administration.

Results
Thirty-six subjects completed the study providing accelerometry data for a total of 253 hospital days (146 ICU days/107 floor days). Mean anesthesia and surgery time was 302±97 and 213±86 minutes, respectively, with no significant difference between CP (n=20) and non-CP (n=16) patients. Over all hospital days, the average daytime activity ratio was 57±8%. For ICU days, the average daytime activity ratio was 55±11%. In 38% of subjects, differences in daytime and nighttime activity were indistinguishable. In a multivariable regression model, increasing age was a predictor of decreased daytime activity (p<0.03). However, CP diagnosis, anesthesia time, surgical time, intraoperative opioid and benzod dose, steroid administration and OR extubation were not predictors of daytime activity ratio.

Discussion
• Circadian rhythms are significantly disrupted in all patients as evidenced by an increase in nighttime activity
• Previous studies demonstrated average daytime activity is 75-80% of total activity in humans with consolidated sleep.
• In this study, derangements in day-night patterns were independent of several intraoperative factors including opioid dose, length of anesthetic, and a diagnosis of CP.
• Sleep is integral to normal neurocognitive development in children, and critically ill patients frequently experience sleep disruptions in the ICU setting.
• Our finding that there is no significant association between intraoperative factors and alterations in daytime activity ratios in children undergoing major orthopedic surgery supports that the ICU environment itself is a great source of sleep fragmentation.
• Noises from machines, therapeutic interventions and even the discomfort of the illness itself can act as factors that disrupt normal sleep and circadian rhythm.

References