Reducing Unnecessary Sleep Disruption for Neonatal Patients

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Introduction

This research addresses the intersection of two sets of well-studied problems in healthcare: problems with clinical alarm systems and supporting healthy sleep in NICUs. The study aims to investigate alarm systems and develop interventions to improve sleep quality for neonatal patients.

Alarms problems

• Alarm hazards are one of the biggest issues affecting patient safety (ECRI, 2012)
• Too many alarms -> alarm overload or fatigue/desensitization; caregivers may not respond appropriately to true health events
• High percentage of clinical alarms are false or “nuisance” alarms – those which do not require a clinical response (e.g., Imhoff & Kuhl, 2006; Seagull & Sanderson, 2001)
• Alarms are often context-insensitive, underspecified, use poor urgency-mapping, and otherwise do not adequately support event management (Woods, 1995)

Current research

• Investigating and documenting the role of clinically-unnecessary alarms and clinically-unnecessary care activities in response to alarms in sleep disruption
• Too many alarms in Neonatal/Pediatric Intensive Care Units: up to 68% false or nuisance alarms and 94% clinically insignificant (Lawless, 1994)
• Alarm signals are frequently above the 65 dB limit (Buxton et al., 2012; Freudenthal et al., 2013)
• Very few alarms are addressed in short time periods (~5% within 30 s (Bitan et al., 2004))
• Caregiver actions taken in response to alarms often involve waking the patient as the first step, especially in response to heart rate, respiration, and oxygen saturation alarms – which are also the most frequent alarms (Bitan et al., 2004)

Supporting sleep in NICUs

• Uninterrupted sleep cycles that include REM sleep are essential for sensory and cognitive development of pre-term and full-term infants. (Graven & Browne, 2008)
• Factors associated with sleep disruption include:
  • Noise levels in the NICU commonly exceed the specified limits: 45 dB average, with peaks no greater than 65 dB (Brown, 2009; Buxton et al., 2012)
  • Care activities which involve waking the child, including common tasks such as feeding, handling, diaper changing, and response to physiological alerts

Study methods

• Literature review, expert interviews (neonatologists, nurses, families) and task analyses (Ferris & Shepley, 2013)
• Observational study at Texas Children’s Hospital, Houston:
  • Classification of alarms, caregiver response activity
  • Sound level data logging
  • Documented sleep-wake states and sleep disruption
  • Physiological data documenting alarm-triggering dynamics and physiological changes following alarms

Ongoing and future work

• Spring 2013: 40-hour data collection in NICU-level II and III at Texas Children’s Hospital
• Smarter alarm algorithm design to improve specificity (without sacrificing sensitivity) of most problematic alarms, esp. apnea and bradycardia
• Improve context-sensitivity in alarm systems; make alarm algorithms and displays adaptive, driven by sleep-wake state
• Explore alternative alarm designs to reduce sound levels:
  • Graded alerts to lower sound levels for less-critical/urgent alarms, especially those which are most frequent; also support better urgency mapping for alarm identification
  • Alternative alarm modalities, such as vibrotactile displays (e.g., Ferris & Sarter, 2011)
• Introduce decision aids and training methods for caregivers to support recognition of when sleep disruption is unnecessary

Further information

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Acknowledgment

This work is sponsored in part by the Center for Health Organization Transformation (NSF I/UCRC)