Reduction of Noise Levels in the Pediatric Intensive Care Unit (PICU) of Beaumont Hospital

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ABSTRACT
Noise levels have increased dramatically in health care facilities as a consequence of many factors, including increase in medical device false alarms, building-related sounds such as clattering carts and humming air conditioning units, and increased numbers of staff. This snowballing noise levels have negative physiological effects on patients and worsen nursing care. This study describes our quantitative research towards reducing noise levels in a hospital critical care unit by means of a behavior modification program. Key words — hospital noise, patient safety, medical device alarm, and human factors.

INTRODUCTION
An Intensive Care Unit (ICU) is a special unit designed to care for the most acutely ill patients within the hospital. Such patients need quiet and attentive personalized care. Unfortunately, it has become very difficult to achieve a quiet environment within ICU units due in part to the monitoring equipment required for these very sick patients. A June 2012 study in the Annals of Internal Medicine examined cortical arousal response to typical hospital noises during sleep. This study recommends that ICUs improve the acoustic environment in order to provide high quality patient care [1]. In a 2010 review on the effects of hospital noise, Choiniere noted that noise has physiological and psychological effects on the body and that excessive noise level has the potential to increase complications in patients. Choiniere also pointed out that, since nurses spend far more time in ICUs than patients, the nursing staff experiences stress from the high levels of noise [2].

The objectives of this study were: 1) To estimate the noise levels experienced by the patients as well as the nursing staff of Pediatric Intensive Care Unit (PICU) in a large Midwestern hospital; 2) To carry out an amplitude and frequency analysis of the noise; 3) To implement appropriate low- or no-cost sound reduction measures and; 4) To quantify the reduced noise levels within the PICU by comparing the noise levels before and after implementation of the sound reduction measures.

MATERIALS AND METHODS
We analyzed the noise levels in four locations within the Beaumont PICU: (a) two patient rooms (the noise recording device was stationary); (b) the nurse station (stationary); and (c) throughout the PICU as recorded by ambulatory noise dosimeter badges worn by the nurses. The data gathered from the noises allowed us to determine whether the noise levels are exceeding WHO and U.S. Environmental Protection Agency (EPA) recommendations for hospital noise. In this regard, the World Health Organization (WHO) (1996) guidelines, which state that “Since patients have less ability to cope with stress, the equivalent sound pressure level should not exceed 35 dBA”[3] (equivalent continuous noise level) L_{eq} should not exceed 35 dBA in most rooms in which patients are being treated or observed. L_{eq} is the average level during the day (7 am to 7 pm) and night (7 pm to 7 am). (Since participation in the study was voluntary, only volunteer RNs wore the noise badges.) We used these devices to measure L_{eq} and L_{max}. L_{max} is the equivalent continuous noise level, which is the average exposure level over the run time. L_{eq} is the peak sound level.

Behavioral Modification Program: In the literature review “Noise in hospital intensive care units—a critical review of a critical topic” (Oct. 2011) in the Journal of Critical Care, Konkani and Oakley found that educational programs to change the behavior of the ICU staff are the most commonly applied and inexpensive techniques to reduce the noise levels[4]. Our behavioral modification program for this study included an educational power point presentation to the ICU staff, as well as discussion with them of recommended practices for reducing noise levels. We advised staff to avoid bedside conversations, to keep phones in silent mode, and to reduce telephone, pager, and overhead speaker volumes. A poster of the behavior modification session was placed in the meeting room to help keep these concepts in view as a reminder.

Data Collection: The data was collected in three separate one week time-frames between August, 2011 to February 2012. The first recording established a baseline, the second measured the effect of the intervention in reducing noise levels, and the third measured the long term effect of the intervention. During each timeframe the data was collected for 7 consecutive days, that is, for 168 hours of data for each week (24hr*7days=168 hours) for a final total of 504 hours (24hr*7days*3 times = 504 hours).

RESULTS AND DISCUSSION
Krueger et al [5] have classified the sources of hospital ICU noises as operational and structural. Operational sources include the noise produced by staff, operating equipment (telephones, pagers, drug delivery tubing system, overhead speakers, medical devices alarms, etc.) and visitors. Structural sources include structural noise produced by ventilation and air-conditioning system, squeaking sounds from opening and closing of doors, and so forth. Since controlling the structural noise sources is expensive and beyond the scope of this study, we focused on reducing the noise generated by operational sources. From the graphs, it is clear that the equivalent continuous noise level L_{eq} in the patient rooms were between the ranges of 45-65 dBA to 65 dBA, which is well above the recommendation of WHO (35 dBA). The equivalent continuous noise level L_{eq} as experienced by nurses RN1 and RN2, was in the range of 60 dBA to nearly 80 dBA. The L_{eq} at the nursing station was between 50 dBA to 60 dBA. Over all, the behavior modification was not effective in reducing the noise levels.

A study published in the Journal of Ergonomics (Aug, 2012) suggests that decision by emergency medical service workers as to whether to adopt workplace ergonomics interventions was strongly influenced by the perceived advantage as to be perceived endorsement by supervisors and superiors [6]. Our own observations during this study backed up these findings.

There are many variables that impact noise levels within the ICU areas of which a behavior modification session can only touch on. The results of this study pointed us towards the importance of management of false alarms; as a consequence, some of the authors of this study conducted a literature review related to false alarms [7]. We are planning to continue this research with a behavior modification program along with alarm management technique to reduce the noise levels in the ICU.

CONCLUSION
Since staff, visitors and operational instruments all contribute substantially to the increasing noise level, it is very important to apply a combined effective program to reduce noise.

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REFERENCES