



## KEY POINT SUMMARY

### OBJECTIVES

This study compares light and sound levels before and after a NICU is changed from an OW floorplan to one comprised of both SFRs and pods to evaluate compliance with NICU standards.

## Comparing light and noise levels before and after a NICU change of design

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### Key Concepts/Context

Previous studies have found that small changes in lighting and sound can create adverse health effects in preterm infants in neonatal intensive care units (NICUs). Many NICUs are shifting from open ward (OW) designs to single-family rooms (SFRs) and multi-bed pods, allowing for better control over lighting and sound levels while promoting familial involvement. This study indicates that pod/SFR designs have lower levels of noise but higher levels of light than OW designs.

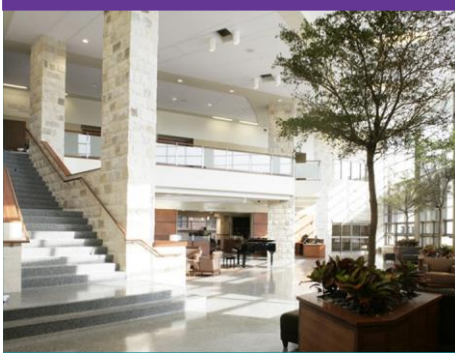
### Methods

This was a pre-test/post-test study that took place in an urban NICU.

During the pre-test phase, the NICU was located in a 34-bed unit with an OW design. This layout placed all three care levels in one 400-square-meter space; there were 14 beds for critical care (level III), 12 beds for semi-critical care (level II), and eight beds for step-down (level I). Nurses worked from a central station located at the entrance of the NICU.

For the post-test phase, the NICU was moved to a new 40-bed unit that was constructed in accordance with the Recommended Standards for Newborn ICU Design as well as the guidelines for design and construction of healthcare facilities. This new design was 1145 square meters in size and featured a combination of pods (each pod consisting of six beds) and SFRs; there were three pods for level III care, two pods for level II care, and 10 SFRs for level I care. Indirect ceiling neon and procedural lights were installed near each infant. Nurses used both a central station and pod-specific stations. Outside windows were triple glazed and equipped with light-filtering blinds featuring double roller shades (including a blackout shade). The floors of the SFRs and pods were covered with sound-absorbent tiles.

For measurements, an Omega HB3336-03 light meter gathered light levels in a horizontal plane, while a Sound Examiner SE-402 captured sound levels on a dBA-weighted scale. Sound measurements were gathered with one decimal in equivalent



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level (Leq). All measurements were gathered over seven days, for 24 hours a day. To compare data from the two NICU designs, statistical analysis was conducted using Stata (version 16).

## Findings

When compared to the OW unit, overall mean light levels were significantly higher in all three of the newer pod/SFR units' care level environments. An F-test for equality of variances found that there was significantly more variability in light levels within the pod/SFR unit. In the OW unit's critical care areas, light readings never surpassed the ambient light recommendation of 600 lux, whereas 11.3% of the pod/SFRs' critical care area light readings exceeded this recommendation. This trend continued in the next two care levels; 27.7% of the pod/SFRs' semi-critical care area readings were over 600 lux while the OW had none, and 9.5% of the pod/SFRs' step down area readings were over 600 lux while the OW had virtually none. No significant difference was found between mean light levels between pods versus SFRs.

The pod/SFR unit had significantly lower sound levels compared to the OW unit during all seven days of analysis. This trend applied to all three care level areas. When compared to the recommended upper sound level of 65 dBA, all three care level areas in the OW exceeded the recommendation significantly more than the pod/SFR units. No statistically significant difference in sound levels was found between the pods and the SFRs.

## Limitations

The authors note that the study of light levels was limited since they did not include measurements in a vertical plane; this could have provided more precise data on how sunlight contributed to the intensity of lighting in the pods. Data were collected on confounding variables such as quantities of windows, infants, staff members, ventilators, and phototherapy lamps; the authors were unable to meaningfully interpret exactly how these variables factored into their comparisons of the units. This study may have benefitted from a longer duration, especially between different seasons where natural lighting levels may shift drastically.

## Design Implications

Outside-facing window orientation, size, placement, glazing, and quantity should be carefully considered in NICUs to avoid consistently exceeding recommended



lighting levels. Installing shades, awnings, or other adjustable fixtures may help provide flexibility for window lighting levels. For sound levels, pods and SFR designs help with significantly reducing unwanted noise.

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