



## KEY POINT SUMMARY

### OBJECTIVES

This study aims to identify inefficiencies in PICU RN workflows, identify high-touch surfaces to help optimize safety, and develop human-centered design solutions.

## Lean design of the pediatric intensive care unit patient room for efficient and safe care delivery

Lu, Y., Bishop, N. B., Zadeh, R. S. 2022 | HERD: Health Environments Research & Design Journal, Volume 15, Issue 4, Page(s) 369-390

### Key Concepts/Context

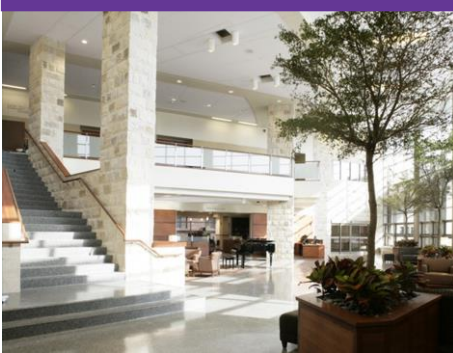
Pediatric intensive care units (PICUs) are often operated by specially trained registered nurses (RNs). Due to the high stress and sensitivity of these environments, optimizing RN workflows and safety protocols is important. Several design solutions are suggested, including increased workspace around the head of patient beds, increased walking space around beds, flexible ceiling-mounted beams, specified and conveniently located zones for trash disposal and supply retrieval, and clear lines of sight to vital-sign monitors.

### Methods

This study took place in the PICU of a large metropolitan hospital featuring 23 patient beds distributed over three single-, one double-, and six triple-bedded patient rooms. This unit sees 1,200 medical-surgical admissions per year. A triple-bedded patient room (approximately 650 square feet) featuring an in-room nurse's communal workstation (approximately 130 square feet) was selected for data collection and observation since this design accounts for the majority of the unit's rooms.

The researchers directly observed RN workflows and kept track of their interactions with various environmental factors within patient rooms. RN spatial movements, equipment surface contact frequencies, and clinical activities were graphically tracked. Additionally, semi-structured in-person interviews were conducted to gauge RN perceptions of their own workflows and work environments.

A total of 13 RNs (41% of total staff daytime nurses) agreed to participate in the observation section of this study. Six of the 13 RNs agreed to participate in both the observation portion and the semi-structured interview. The RN age range was from



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20 to 35 years old, and nurse-to-patient levels were 1:1 or 1:2 based on acuity levels. RNs with less than one month of experience in the PICU were excluded.

Quantitative data were gathered using observation sheets featuring three elements: a spatial movement map (SMM), a clinical activity map (CAM), and a surface contact transmission map (SCFM). Qualitative data came from all behavioral observations and semi-structured interviews.

A total of 35 hours of observation over five consecutive weekdays took place within three identical spatial layouts. Interviews lasted 15 to 30 minutes and were conducted during normal work hours.

## Findings

Within the 35 hours of observation, 48 observation sheets were completed while 13 RNs cared for 10 patients. 539 RN clinical activities were recorded, along with 156 surface contacts.

SMM results revealed that most RN movements occurred between left and right bedsides and the disposal area (25.9%), between the two sides of the patient bed (19.7%), and between the disposal area and the nurses' workstation (13.5%). All other movements between spaces accounted for less than 10% of overall movement. CAM results revealed that checking IV status comprised 39% of patient care activity. SCFM results showed that the surfaces most frequently touched were patient bed rails (63 times), IV pumps and poles (26 times), bedside medical equipment and tubing (23 times), and monitor screens on vital signs (20 times).

These data confirm previous findings that 50% of RN time is allocated to direct patient care. Further analysis shows that 27% of these direct care activities involved attempting to access equipment and supplies, which are considered non-value activities that should be minimized. Due to spatial arrangements, such activities involve frequent travel between clean and soiled areas, thus increasing the likelihood of infection transmission. The authors argue that this could be prevented through adjustments in spatial arrangements.

Interview results supported this idea, with participants noting that they occasionally felt endangered due to lack of space, or disorganized due to lack of convenient surfaces for the placement of supplies. It was also revealed that the existing vital-sign monitoring screen system was often hard to see or required frequent unalarming, which resulted in high amounts of surface contact and workflow disruption.

## Limitations

This study was limited to a single room within one PICU; although this room was one of four identical triple-patient rooms, expanding the study to include additional



PICU types may help establish generalizability. Although it is evidence-based, the authors note that their three-part assessment tool has not yet been validated using existing standards for workflow efficiency. A relatively small number of RNs were interviewed, and no overnight observations were conducted. Lastly, the authors note that interviewing family members could have added further perspective to the RNs' behaviors.

### Design Implications

The following designs could help improve RN efficiency and overall bedside performance while possibly reducing rates of infection: increasing walking space around patient beds, creating designated trash zones, making supply stations centrally located and easily accessible, ensuring a clear line of sight to vital-sign monitors, providing access to sinks and alcohol-rub dispensers, and orienting the room such that staff movement flows from clean areas to dirty areas.

### And Also...

This study includes a novel visual tool intended to help identify the impact of the physical environment in PICU patient rooms on staff efficiency and hospital-acquired infections.

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