

Knoll Workplace Research

Destination Bedside

A Design-Research Project for Effective Nursing
and Patient Spaces

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Effective patient unit design can improve a variety of outcomes

Healthcare facilities are busy, intense environments as well as active workplaces in which the most personal and complex services are rendered—sometimes resulting in stressful conditions for patients, visitors and staff. For nurses on the front lines of patient care, the work environment can have significant negative impacts, contributing to fatigue, distractions, medication errors, patient falls and other issues that affect patient care.¹

However, while environmental factors can play a harmful role, research also suggests that unit layout and design can positively impact the quality of the nursing work experience, quality of patient care, and critical outcomes such as medication errors^{2,3} and patient falls.⁴

This conclusion is based on a study in which Knoll and HOK⁵ jointly investigated the impact of medical-surgical inpatient unit design on quality of patient-centered care (PCC), measured by distractions, correct equipment operation, and walking distances; and by patient outcomes, measured by falls, near falls and pain levels. In a three-phased research program, this project gathered and analyzed qualitative and quantitative data from hundreds of patients and staff that identified beneficial design attributes, conducted problem-solving sessions with nurses, and from these activities developed a design concept that might improve patient outcomes.

There is room to improve the decentralized nursing station approach

A typical medical-surgical inpatient unit consists of patient rooms, nurse stations, hallways, and a core of support spaces. Nursing units of the past were designed with

one centralized nursing station. This approach has a variety of shortcomings related to effective use of nurses' time, long walking distances, and low patient contact time. More recently, decentralized nurse stations have become commonplace, because they increase the efficiency of nurses' work and time spent on patient care. These stations may include medication and supply storage, hand washing facilities, worksurfaces for charting, a computer, and tele-communication devices. Typically, decentralized nurse stations are located in close proximity to patient rooms. An observation window enables nursing staff to look directly into some patient rooms while other rooms on the unit are just steps away.

Decentralized nurse stations may lead to fewer patient falls because nurses work in closer proximity to their patients and are better able to identify when they need assistance. In addition, decentralized nursing stations reduce staff walking and increase patient care time, especially when supply spaces are also decentralized and placed nearby.⁸

While the decentralized approach to placement of nursing stations is now accepted practice, there is a healthy debate about how to best configure these elements on a unit for optimal operations and care delivery.

This study empirically explored relationships between design and nursing/patient outcomes and translated those results into design concepts

The aim of this study was to explore relationships between conditions such as unit

The costs of medication errors and patient falls are not trivial

Medication errors represent the most common medical error, causing more than 7,000 annual deaths. Interruptions and resulting distractions are a leading cause of errors in dispensing medication.² A nurse may be distracted, on average, 6.7 times an hour.³ During medication preparation, major sources of interruption include other nurses and searches for missing medications and equipment.⁴ Research showed a 6.6% error rate for sets of prescriptions administered with only one interruption.⁵

Patient falls account for 6.4% of unexpected occurrences in hospitals that result in death or physical or psychological injury.⁶ Costs of injuries due to patient falls are projected to be \$32.4 billion by the end of this decade, with a current average per patient cost to hospitals of \$24,962.^{7,8} Further impacting costs to hospitals, patient falls and injuries are now directly tied to hospital reimbursement. Hospitals are no longer reimbursed at a higher rate to compensate for the increased cost of care associated with a fall that occurred during hospitalization.⁹

design and layout, and the impact of those elements on nursing workflow and patient care outcomes—and to translate those results into design concepts that could improve upon the decentralized nursing space model. The study consisted of three phases and used a variety of qualitative and quantitative methods.

The study site was a US, academically affiliated teaching hospital located in an urban area. The hospital has 247 adult medical surgical inpatient beds located in seven units, all of which were included in the study. All of the units have computers-on-wheels and balanced headwalls with identical locations for gasses, outlets, and call buttons on both sides of the patient beds.

Phase 1: Assess nursing workflow and patient experience

The objective in this phase was to understand nursing workflow patterns and the patient experience. We used questionnaires, completed by 89 registered nurses and 109 patients, compared nurse scores to their patients' scores, and examined relationships among unit layout, technology use, care delivery, nursing workflow, and patient outcomes.

Research results and implications

Outcome Measure	Research Result	Implication
Patient pain intensity	Amount of time nurses spent in documentation tasks at the main nurses station is a predictor of patient pain level	The more time nurses spend at the main nursing station, the higher the level of pain reported by patients
	Difficulty of patient bed-to-bathroom transfers is a predictor of a patient pain level	The more difficulty patients experience getting to the bathroom within their room, the higher level of pain they reported
Nurse walking distances	Amount of time nurses spent in documentation tasks at the main nurses station is a predictor of amount of walking	The more time nurses spend documenting at the main nursing station, the more they walked
	Number of trips per hour for nurses to the main nursing station for documentation work is a predictor of number of trips to patient rooms per hour	As the number of trips to the main nursing station increase, trips to the patient room decrease
Patients' near falls	The patient bed-to-bathroom transfer is a predictor of near falls reported by patients	While the bed-to-bathroom transfer is a cause of increased near falls, having the nurse conduct documentation work at the bedside is a predictor of reduced number of near falls
	Nurses' frequency of documentation at the patients' bedside is also a predictor of patient near falls	
Distractions during medication administration	The process of preparing medications at the computers on wheels is a predictor of nurse distraction level	As medication preparation at the computers on wheels increases, so do distractions for nurses
	The number of trips per hour by nurses to centralized patient medication storage is a predictor of reported nurse distractions	As the number of trips per hour increases, the level of distractions reported by nurses increases

Table 1. Aspects of the location and physical setting of various care activities directly affect important patient and nursing outcomes.

Phase 2: Identify spatial and healthcare information technology (HIT) features related to patient care

The purpose of this phase was to identify unit layout, HIT, and care delivery characteristics that contributed to or detracted from patient care at bedside. We conducted a work sampling investigation which monitored, over a period of 111 day and evening shifts, nurses' walking distances (measured by wearing a pedometer), space use, HIT use, and frequency of patient care at bedside.

During this phase, each nurse carried a PDA device that rang randomly 30 times per 12 hour shift, prompting the nurse to record their setting (location) and activities using a survey form. We used multiple regression techniques to reveal the predictive relationships between unit characteristics, care delivery activities, nurse outcomes such as job satisfaction, and patient outcome measures.

Phase 3: Translate research and practical insights to design

Finally, we combined the research findings from phases one and two with the practical insights from nurses into general design guidelines for the workspace. We used a "charrette," a common brainstorming and

ideation technique employed by architecture practices to generate visual solutions to a stated problem. During the design charrette, three groups of 40 nurses heard a review of research findings from the first and second phases of the study, discussed this information, and interacted with an interior designer to create sketches of "ideal" unit and patient room layouts.

We found significant relationships between design variables and outcomes

Table 1 summarizes key research findings from Phase 2 of this study. The analyses show that aspects of the location and physical setting of various care activities directly influence patient and nursing outcome measures in several ways.

The analysis shows that the location of nursing work affects patient pain level, nurse walking distance and time spent at the bedside (Table 1). These results point to an opportunity to reduce patient near falls by shifting more care time to the bedside.

The results also imply that there are opportunities to reduce nurse distractions in rethinking where medication administration activities take place (Table 1).

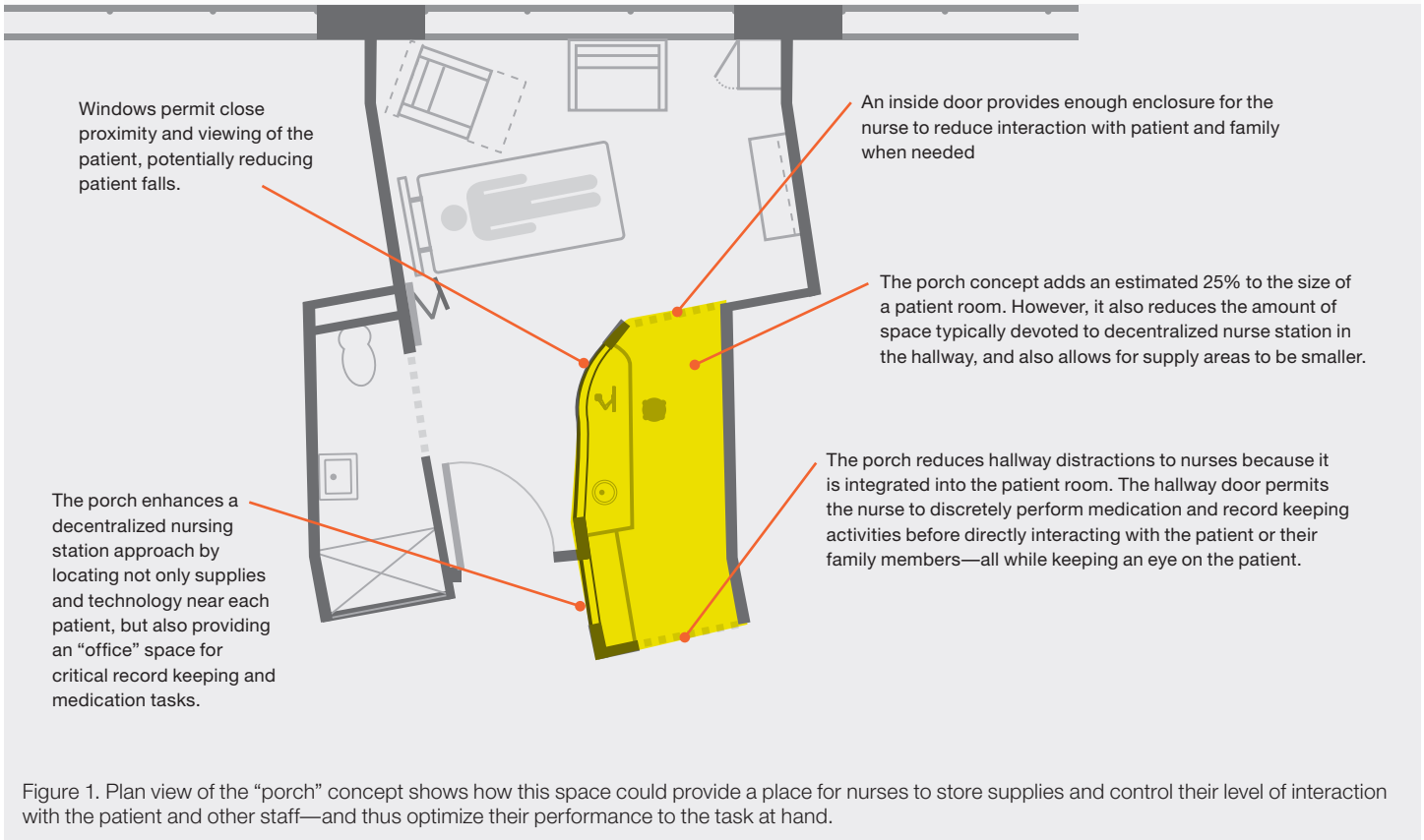
"Nurses are working in a variety of places— at the nurse station, in the patient room, and now quite often in the hallway, at decentralized stations or with computers-on-wheels. This constantly exposes them to distractions and interruptions."

– NURSE, STUDY PARTICIPANT

There is a tension between the need for interaction between nurse and patient—and resulting distractions to the nurse

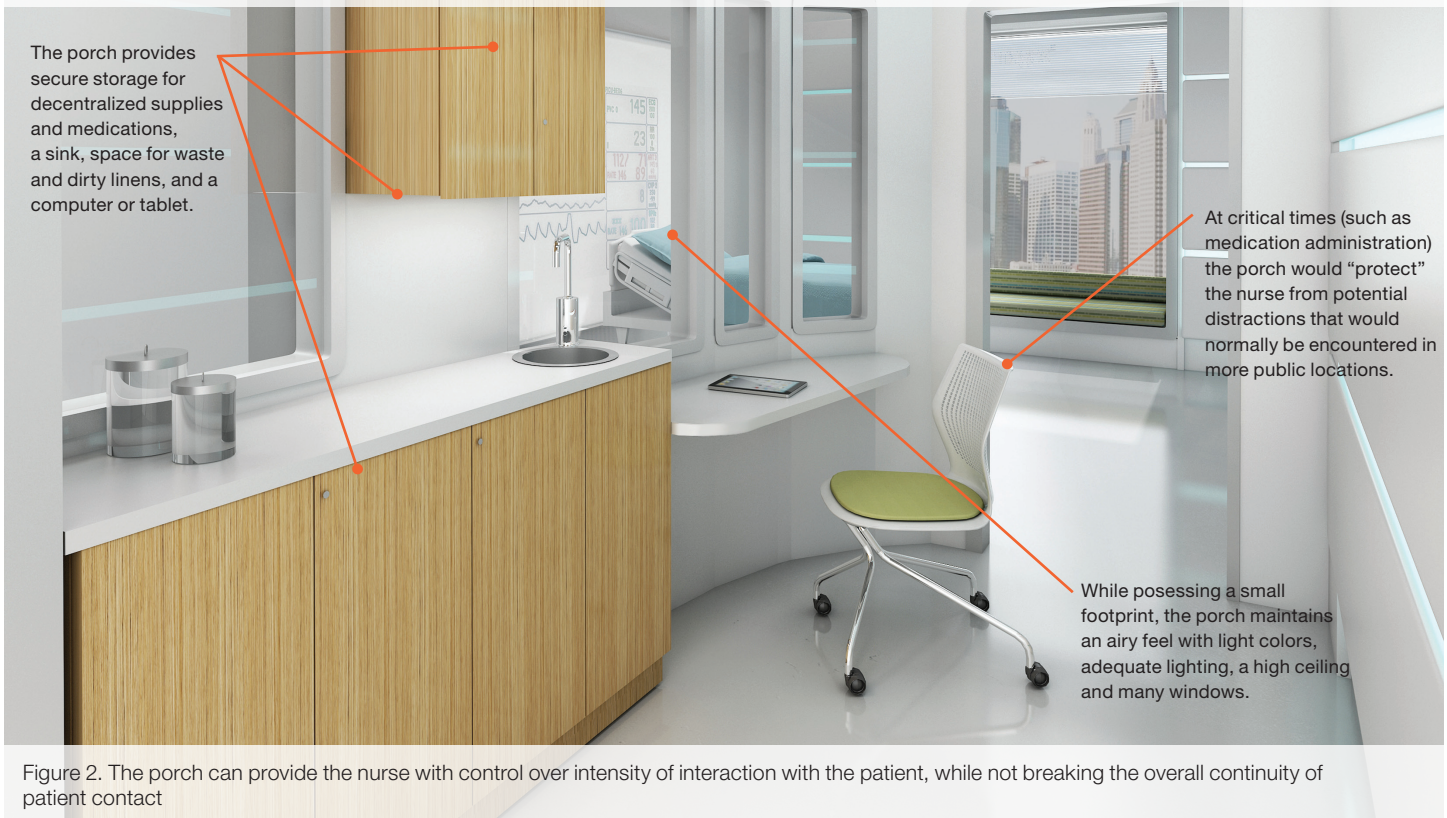
A unique aspect of this study was that nursing staff was directly involved in the development of design concepts—both by reacting to data from this study, and by drawing on their practical work experience. A key insight is that simply providing more bedside time with patients will not alone be sufficient to improve outcomes. Rather, there exists a tension between the need for greater interaction with patients and negative outcomes caused by nurse distractions and other interactions during critical phases of care that must also be addressed.

Plan view of a patient room with interior “porch”



Interior of porch provides visual access to patient and a distraction-free areas for the nurse to work

As a separate room embedded within the patient’s room, the porch keeps the nurse near the patient



Evolution of planning concepts for nursing stations

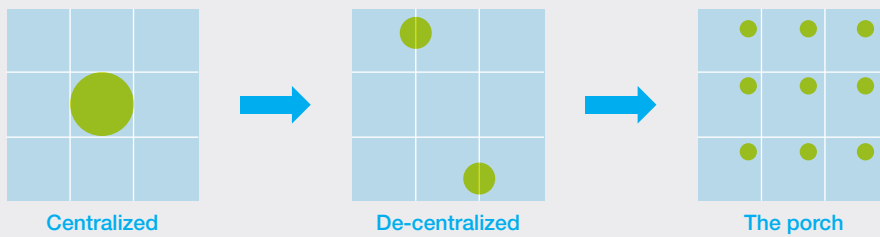


Figure 3. The porch concept represents a new endpoint in the development of effective planning models for nursing stations

A more nuanced approach to patient interaction is needed. The patient space needs to provide features that help nurses to mediate their ongoing depth of interaction with patients, visiting families and other staff. Design of the space should offer nurses control over ongoing intensity of interaction by providing an area adjacent to the bedside that offers varying levels of visibility to others (Figure 1).

Thus, we developed the concept of a “porch,” a separate room embedded within the patient’s room that is intended to keep the nurse near the patient while providing a sheltered, adjacent space that would mediate distractions caused by the patient or by other people in the room and in the hallway (see Figure 1). For nurses, the porch would permit close proximity and observation of the patient without requiring them to actually be in the patient’s room. The porch would also provide decentralized storage for supplies and medications, a sink, space for waste and dirty linens, and a dedicated computer.

Conceptually we see the porch concept as part of the ongoing evolution of planning strategies that started with centralized nursing stations, and is connected in its intent to the more recent developments of the de-centralized planning model.

The porch is designed to provide the caregiver control over the level of interaction with others. It would enable the nurse to proactively minimize distractions when needed at key moments in the care process (Figure 2). For instance, at critical times (such as medication administration) the porch would “protect” the nurse from potential distractions that would normally be encountered when accessing medications in a centralized location. Within the porch, the nurse could briefly withdraw

from the patient bedside while remaining nearby to monitor, focus as needed on the medication process, and then re-engage with the patient and family when actually administering the medication. The buffering provided by the porch would also permit the nurse to temporarily reduce bedside interaction when entering data or operating equipment. This would increase the efficiency of equipment use and potentially reduce data input errors due to distractions.

This research suggests that the porch concept could result in improved patient-centered care

The benefits emerge from three perspectives: patients, nurses and hospitals.

Benefit 1: Higher quality patient care and faster recovery

Having nurses in closer proximity to patients through the porch concept could enhance patients’ perceptions of the quality of care and lead to faster recovery. Potential outcomes include better ongoing monitoring of patients, increased accuracy of medication administration, reduced pain, and fewer patient falls because nurses would spend more time nearby.

Benefit 2: Fewer distractions for nurses

Reducing the number of steps taken by nurses as they attend to their patients and search for supplies would likely decrease their fatigue. Nurses would be able to increase time at the bedside and experience fewer distractions or interruptions as a result of spending less time in the hallway or at a central station. Nurses may experience fewer distractions during preparation and administration of medications and when

“The nursing job is all about increasing efficiency, reducing footsteps, minimizing errors. The porch looks like a concept that deserves a close look since it appears to address those issues.

– NURSE, STUDY PARTICIPANT

charting, and potentially have fewer issues operating equipment.

Benefit 3: Better financial results for hospitals

Hospitals may be able to reduce risk of patient falls and their significant associated costs, improve patient satisfaction scores, and also reduce staff turnover due to better working conditions. While the “porch” concept may require greater square footage for patient rooms than conventional designs, space may be conserved by reallocation from centralized nurse stations or supply locations. And, while computers-on-wheels would probably be needed less frequently, additional computers and monitors would be required in order to equip each porch for charting.

The porch concept represents a fresh approach to the decentralized nursing station model

The porch concept is an extension of the decentralized nursing station model that has the potential to improve the patient experience and staff satisfaction. Hospitals, their patients and their staff may all benefit from exploring and implementing this concept.

This project uses an evidence-based design approach in the development of effective patient spaces. The next step is to empirically test these ideas through a pilot project. Such a pilot might be implemented on one unit/floor of a hospital with another unit/floor used as a control. Metrics could include patients’ length of hospital stay, complaints of pain, falls, and patient and staff satisfaction scores.

Notes

- ¹ The Joint Commission. (2008). Chapter One, Causes and Effects of Fatigue in Strategies for Addressing Health Worker Fatigue. Oakbrook Terrace, IL: The Joint Commission, 1-20.
- ² Reiling J. Safety by Design: Designing Safety in Healthcare Facilities, Process, and Culture. Oakbrook, Terrace, IL: Joint Commission Resources; 2007.
- ³ Chaudhury H, Mahmood A, Valente M. The Effect of Environmental Design on Reducing Nursing Errors and Increasing Efficiency in Acute Care Settings: A Review and Analysis of the Literature. Environment and Behavior. 2009. 41(6), 755-786.
- ⁴ Tucker AL, Singer SJ, Hayes JE, Falwell A. Front-Line Staff Perspectives on Opportunities for Improving the Safety and Efficiency of Hospital Work Systems. Health Services Research Journal, 2008. 43(5 Pt 2), 1807-1829.
- ⁵ HOK is a global architectural firm that specializes in planning, design and delivery solutions for buildings and communities.
- ⁶ Watkins, N. (2011). The Impact of Medical-Surgical Workflow and Unit Layout on Patient and Staff, submitted for publication.
- ⁷ Rashid, M. A Decade of Adult Intensive Care Unit Design: A Study of the Physical Design Features of the Best-Practice Examples. Critical Care Nursing Quarterly, 2006. 29(4), 282-311.
- ⁸ Hendrich A, Fay J, Sorrells AK. Effects of Acuity-Adaptable Rooms on Flow of Patients and Delivery of Care [Electronic version]. American Journal of Critical Care, 2004. 13(1).

Through research, Knoll explores the connection between workspace design and human behavior, health and performance, and the quality of the user experience. We share and apply what we learn to inform product development and help our customers shape their work environments. To learn more about this topic or other research resources Knoll can provide, visit www.knoll.com/research/index.jsp



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