Hospital Inpatient Unit Design Factors Impacting Direct Patient Care Time, Documentation Time, and Patient Safety

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ABSTRACT

This study attempts to discover design strategies that support increasing nurses' patient care goals of direct patient care time, safety, and quality. This is a national-scope study of 14 inpatient units with various typologies. The study uses ratings of 135 nurses who work in these units gained from online surveys and correlated with unit typology classifications based on analysis of floor plans of the units where these nurses work. The findings discovered certain locations and qualities for support resource locations (medications, supplies, and equipment), that are most beneficial to nurses' patient care goals, and which types and locations of collaboration locations and electronic medical record workstations are more effective. Results of the study are usable by architects in designing or remodeling effective inpatient care units.

The findings of the study confirm that reducing walking distance benefits the patient care goals for support resources, but goes beyond that to discover that zoning of supplies into modules may be even more important. The study further found that medication room size is an important indicator of patient safety. It's more important to know where equipment items are stored consistently than to reduce the distance to equipment rooms.

Healthcare staff favored documentation locations closest to a patient. Closest was best.

Introduction

Which design factors work best to increase nurses' direct patient care time, safety, and quality? This study attempts to answer this question in a national-scope study of 14 inpatient units with various floor plan concept typologies. The study uses ratings of 135 nurses who work in these units, correlated with unit typology classifications based on analysis of floor plans of the units where these nurses work.

The findings show locations and qualities for support resource locations (medications, supplies, and equipment), that are most important to nurses and types and locations of collaboration locations and electronic medical record workstations that are more effective. Architects can use the study results to inform designing or remodeling effective inpatient care units. A team of architects performed the research, supported by nursing and research advisors and by an Academy of Architecture for Health Foundation research grant.

Background

Architects frequently hear the following objectives for hospital acute care inpatient units (beyond those of treating illness or aiding recovery from surgery or trauma) from hospital clients:
- quality of care
- patient safety
- staff safety
- staff satisfaction
- patient experience/satisfaction
- family participation/education
- reduction of distraction and interruptions for effective staff concentration
- multidisciplinary collaboration
- lean operations

When designers, working with hospital end-user committees, are planning a new hospital inpatient care unit, they are faced with difficult choices in configuring staff work and support resource areas within an overall unit plan to accommodate all of these objectives.

Context and program differences for each inpatient unit design include the following:
- variation in unit size (number of beds) and shapes (racetrack, triangles, Ls)
- specialization (medical, surgical, ortho, neuro, oncology, progressive care, etc.)
- varied nursing practice models
- different types of electronic medical record systems and degrees of adoption
- varying ancillary support methods (nurse servers vs. supply alcoves vs. central supply rooms; central medication rooms vs. satellite med stations, equipment inventory and degree of decentralization, etc.)

Within the context of overall organizational strategies and flow concepts, architects must make choices as to the degree of decentralization for locations of spaces for documentation, collaboration, and support resources.

In inpatient care units (IPU) today, nurses are challenged to have adequate time for direct patient care due primarily to a higher level of patient acuity. (Hendrich et al., 2007), in their time-motion study of how nurses spend their time, found that nurses only spend 19% of it on direct patient care.

Electronic medical records (EMR) systems now allow nurses to decentralize their documentation activities in the unit, with the promise of more time at the bedside. In their comparison of centralized and decentralized units, (Gerascio-Howard and Malloch, 2007) concluded that in the decentralized unit, RNs were able to spend more time in patient rooms (30% for decentralized vs. 26% for centralized). However, if decentralization of documentation isn't accompanied by the effective location and quality of support resource centers (medications, supplies, linens, equipment and collaboration spaces), nurses must take extra time to access these spaces, which reduces available time for direct patient care and documentation. There is a need to understand the nurses' perspective of how different locations and types of spaces for documentation, collaboration, and support resources contribute to their patient care goals.

Documentation

The most frequent and continuous activity for nurses is documentation of medical records and care coordination/planning (56% in the study by (Hendrich et al., 2007). EMR's emergence shows that it allows freedom of decentralization and ubiquitous access not possible in the past. Many solutions have emerged to accommodate this activity—corridor alcoves; open spaces near corridors, satellite groupings, and in patient rooms. (Cai and Zimring, 2011) posit that there are four typologies for nurse stations: central, sub-nurse stations (satellite stations), pod clusters, and mobile.

Collaboration

In some cases, decentralization has led to reduced communication and mentoring among caregivers. Becker (2007) suggests the importance of collaboration, mentoring, and consultation in creating a "community of practice" for quality of care on the unit. (Cai and Zimring, 2011) cite numerous studies showing reduced communication among nurses in units with decentralized nurse stations. (Zborowsky, et al., 2010) compared centralized and decentralized units and

found communication with medical staff and other social interactions were reduced in the decentralized units. (Gerascio-Howard and Malloch, 2007), in their comparative study of centralized versus decentralized units, report that "RNs regretted a lack of contact with care partners and information lost from fewer networking opportunities." However, they also noted that a nurse locator system created opportunities for team communication. Decentralization in and of itself doesn't necessarily imply a lack of communication—specific design solutions definitely play a part. (Trzpuc and Martin, 2010) studied three types of decentralized units. Using space syntax methods, they concluded communication is enhanced by open visibility, allowing opportunistic meetings, and accessibility (path length).

Support resources

The need for decentralization of medications, supplies, and equipment spaces to reduce nurse walking distance is often cited as a way to deliver safe, efficient and effective patient care. (Hendrich, et al., 2009) found that nurses spend 17%of their time administering medications. (Cardon, 2011) points out that medication errors are a significant factor related to distance between medication rooms and patient beds. Her study shows that one-third of the medication errors occur during the administration of the medication, from interruptions along the way, and from batch processing of multiple orders that can lead to dosing the wrong patient.
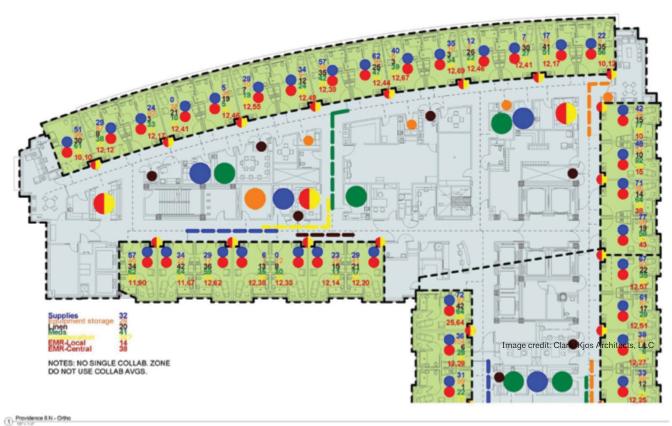
Hypothesis

The hypothesis of this study is that the location of the EMR documentation spaces, collaboration spaces, and support resources (medications, supplies, linens and equipment) locations have an impact on nurses' direct patient care time, documentation time, safety, and overall effectiveness (effectiveness criteria). More specifically, we hypothesized that nurses would favor unit designs with the shortest average walking distance between these resources and the patient. The study was designed to correlate a detailed survey of nurses' ratings for their unit design, using the effectiveness criteria, with the physical features of the floor plan. By comparing multiple units, we hoped to show that nurses would judge certain units' features are more successful than others in supporting the effectiveness criteria.

FIGURE 1

Floor plan example: MultiCare Good Samaritan Hospital 6th Floor Medical Unit, Puyallup, WA
Image credit: Clark/Kjos Architects, LLC

FIGURE 2

Floor plan example: Providence Medical Center 8-N Orthopedics, Portland OR
Image credit: Clark/Kjos Architects, LLC

Methodology

Fourteen units were included. Design architects of each unit provided digital floor plans. The research team normalized floor plans for consistency and confirmed exactly how each unit was being used.

Four nurses from each shift at each facility completed a detailed survey. Questions sought ratings of how certain locations of support resources supported patient care goals. Rating questions allowed the nurses to respond on a 1–5 scale: from 1 (not at all effective) to 5 (very effective). Nurses' ratings for each unit were averaged to create one score for that facility.

This research investigates three interrelated design problems for inpatient unit support resources, described below.

Support resources spaces

Research question: Is there a correlation between the location of certain support resources (medications, supplies, equipment), and nurses' perception of their impact on direct patient care time, documentation time, and patient safety?

Nurses' ratings were correlated with average distance between the patient room and the closest medication station(s) to accurately test the hypothesis that the nurses would feel that shorter walking distances would support the three patient care goals.

Medications

See table 1, which correlates distance to nurse rating of the resource location's support of the three patient care goals (higher distance, in feet, should equate to a lower time availability, while higher rating scores indicate more time for the nursing goals). Colors help to visually express the pattern of values, from red for long distances to green for short distances, and the same scale for low to high ratings. The data shows that there is a correlation of travel distance to the nurses' ratings of support for the patient care goals. Approximately one-third of the units are outliers and do not correlate well. Therefore, the research team concluded that additional factors figure in the nurses' ratings.

Comments from the nurses included the point that frequently there is a wait at the medication dispensers, offsetting the proximity advantage some of the time, so we attempted to correlate number of patients served by each med room (more beds per med room would indicate more time delays, while higher rating scores indicate more time for the nursing goals). See table 2. However, there was no consistent correlation.

There is anecdotal evidence that availability of work space in medication rooms can be a factor in patient safety. The research team correlated nurse safety ratings with two different factors:

TABLE 1

	Norton Brownsboro — Centralized serving 21+	Harrison 2S (Med/Surg) — Decentralized serving 11-20	Harrison 2W (Oncology) — Decentralized serving 11-20	Good Sam Puyallup 6 — Centralized serving 21+ patients	St. Charles 3 Ortho Unit — Centralized serving 21+	St. Charles 4 Medical Unit — Centralized serving 21+	Good Sam Puyallup 4 — Decentralized serving 11-20 patients	Prov Portland 8N (Ortho) — Decentralized serving 5-10 patients	Emory Johns Creek Hosp. — Decentralized serving 11-20	St. Charles Redmond — Centralized serving 21+ patients	Good Samaritan Corvallis — Decentralized serving 11-20	Samaritan Lebanon — Corridor cabinet serving 1-4 patients	Prov Portland 8S (Neuro) — Decentralized serving 5-10 patients	Samaritan Albany — In pat room (nurse server) and central location
Ave dist to combined locs	78	71	70	70	55	45	44	41	38	37	35	34	28	10
Time for care	3	2.4	3.3	4	3.6	3	3.3	3.9	3.9	3.8	2.9	4.3	4.1	3.9
Time for documentation	3.5	2.8	3.1	3.9	3.9	3.1	3.2	4	3.9	3.8	2.8	4	4.1	3.6
Patient Safety	3.9	3.5	3.3	3.9	3.9	3.1	2.8	4.1	4.1	4.2	2.9	3.7	4.4	4.4

Medications locations by distance (Note: Colors are used to help visually express the pattern of values, from red for long distances to green for short distances, and the same scale for low to high ratings).

TABLE 2

	Norton Brownsboro	Good Sam Puyallup 6	St. Charles Redmond	Harrison 2S (Med/Surg)	St. Charles 3 Ortho Unit	St. Charles 4 Medical Unit	Good Sam Puyallup 4	Emory Johns Creek Hosp.	Good Samaritan Corvallis	Harrison 2W (Oncology)	Prov Portland 8N (Ortho)	Prov Portland 8S (Neuro)	Samaritan Lebanon	Samaritan Albany
	Centralized serving 21+	Centralized lserving 21+ patients	Centralized serving 21+	Decentralized serving 11-20	Centralized serving 21+ patients	Centralized serving 21+ patients	Decentralized serving 11-20 patients	Decentralized serving 11-20	Decentralized serving 11-20	Decentralized l serving 11-20 patients	Decentralized serving 5-10 patients	Decentralized serving 5-10 patients	Corridor cabinet serving 1-4 patients	In pat room (nurse server) and central location
Beds /med rm	24	20	18	18	13	12.5	1	12	12	12	8.7	7.3	5.3	1.0
Time for care	3	4	3.8	2.4	3.6	3	3.3	3.9	2.9	3.3	3.9	4.1	4.3	3.9
Time for documentation	3.5	3.9	3.8	2.8	3.9	3.1	3.2	3.9	2.8	3.1	4	4.1	4	3.6
Patient Safety	3.9	3.9	4.2	3.5	3.9	3.1	2.8	4.1	2.9	3.3	4.1	4.4	3.7	4.4

Medications locations by number of patients per med room (Note: Colors are used to help visually express the pattern of values, from red for long distances to green for short distances, and the same scale for low to high ratings).

1. total amount of medication room area per unit expressed as square feet per bed
2. average medication room or space in square feet

In correlating square-foot area per bed, the relationship is quite consistent with safety scores. Refer to table 3. Highlighted in the table, units with the largest total size of med room space (7.8 square feet per bed and above) received very high ratings (3.9 and higher). Units with med rooms below that size all received scores of 3.5 or lower, with only one facility not fitting this pattern (Norton Brownsboro).

In correlating average square-foot area per med room, the relationship is again quite consistent with safety scores. Refer to table 4. As highlighted in the table, units with the largest average med room size (82 square feet per med room and above) received very high ratings (3.9 and higher).

Variables noted in nurses' comments which were taken into account in analyzing the data include the following:
- Often, medication administration requires visits to multiple locations. Supplies (i.e., IV tubing, syringes, etc.) are sometimes in a separate location from the medications. Not all medication rooms on a unit have the same stock, due to capacity limits. Pharmacy staff

TABLE 3

Unit	Tot size of all med rooms as sf/bed	Ave. safety score
Providence 8S	14.1	4.4
Providence 8N	12.6	4.1
Good Samaritan Puyallup 6	10.4	3.9
St Charles Bend 3	8.4	3.9
Emory Johns Creek	8.0	4.1
St Charles Redmond	7.8	4.2
St Charles Bend 4	7.1	3.1
Good Samaritan Corvallis	6.0	2.9
Good Samaritan Puyallup 4	5.9	2.8
Norton Brownsboro	5.8	3.9
Harrison West	3.3	3.3
Harrison South	2.1	3.5

TABLE 4

Unit	Ave. med rom size	Ave. safety score
Good Samaritan Puyallup 6	219	3.9
St Charles Redmond	140	4.2
Norton Brownsboro	140	3.9
Providence 8N	109	4.1
Providence 8S	103	4.4
Emory Johns Creek	96	4.1
St Charles Bend 3	82	3.9
Good Samaritan Corvallis	80	2.9
Good Samaritan Puyallup 4	71	2.8
St Charles Bend 4	57	3.1
Harrison West	36	3.3
Harrison South	36	3.5

often does not restock adequately. These problems usually result from undersized med rooms. This was taken into account by averaging the distance traveled to one or two med rooms in the percentage of times that the nurses stated that they needed to access two med rooms in table 1.

- Because medications are given at standard times, there is often a backup at med dispensers, especially in medical inpatient units, where more medications are involved.

Supplies

See table 5, which attempts to correlate the distance to the nurses' rating of the resource location's support of the three patient care goals (higher distance in feet, should equate to a lower time availability, while higher rating scores indicate more time for the nursing goals). Colors are used to help express visually the pattern of values, as with the medications data. The data shows that there is a partial correlation of travel distance to the nurses' ratings of support for the patient care goals. Approximately one-quarter of the units are outliers and do not correspond. The research team therefore concluded that other factors figure in the nurses' rating.

See table 6, which correlates type of decentralization (rather than distance) with the nurses' ratings (more centralized locations should equate to a lower time availability, while higher rating scores indicate more time for the nursing goals). Here there is a more compelling correlation, with only one outlier. Possibly there is a greater sense of control over the supply chain when it is more dedicated to a small neighborhood.

Below are variables noted in nurses' comments that were considered in analyzing the data:

- Supply centers often don't have comprehensive stock, or don't get restocked quickly, causing travel to more than one location. This was taken into account by averaging the distance traveled to one or two med rooms in the percentage of times that the nurses stated that they needed to access two supply rooms in table 5.

Equipment

See table 7, which correlates distance to nurse rating of the resource location's support of patient care goals (higher distance in feet should equate to a lower time availability, while higher rating scores indicate more time for the nursing goals). Colors are used to help express the pattern of values visually, as with the medications, supplies, and linen data. The data shows there is a poor correlation of travel distance to the nurses' ratings of support for the patient care goals. Therefore, the research team concluded

that distance to the nearest equipment location is not a primary factor in the nurses' rating.

Refer to table 8, which correlates type of decentralization (regardless of distance) to the nurses' ratings (higher centralization should equate to a lower time availability, while higher rating scores indicate more time for the nursing goals). Here there is also a poor correlation.

Nurses' comments related to equipment:

- Equipment rooms are usually too small; therefore, equipment is placed in multiple locations, causing nurses to travel to multiple locations to find it.
- When decentralized equipment closets are used, the equipment isn't always returned to its rightful place, again causing nurses to hunt and gather. Central equipment rooms scored as well or better than decentralized locations, indicating that reliability of location is more important than distance.
- It was noted that the scores are relatively low in general, indicating that equipment gathering is a significant problem at most units.

**Documentation
(electronic medical record [EMR]) space**

Research question: Is there a correlation between the different location types of documentation space (using EMR system), and nurses' perception of their impact on direct patient care time, documentation time, patient safety, and minimizing noise and distractions?

Below, survey results are summarized for ratings of four different patient care impacts based on type of location for the EMR.

Impact on time for direct patient care
All decentralized EMR locations were favored over centralized, with those closest to the patient favored the most. This seems logical since nurses can better observe patients when they're located closer to documentation activity.

An interesting finding emerged from this data. In patient rooms with fixed EMR, the average rating was 4.7 out of 5 (very high), while the average rating was 3.6 (considerably lower) in rooms where mobile EMR is used. We received comments that the mobile EMRs are cumbersome to move around, and we have heard this often outside of the study.

Impact on time for documentation
The corridor alcove was rated best, the satellite a close second best, the patient room third best, and the central location a distant fourth. Possible reasons for this rating include that it is preferable to be proximate to the patient, but slight separation from the patient and family increases concentration and efficiency when documenting.

TABLE 5

	Norton Brownsboro — Centralized serving 21+	Good Sam Puyallup 4 — Centralized serving 21+ patients	Emory Johns Creek Hosp. — Decentralized serving 11-20	Samaritan Lebanon — Decentralized serving 11-20	St. Charles 3 Ortho Unit — In patient room (nurse server),	St. Charles 4 Medical Unit — In patient room (nurse server), central	Samaritan Albany — In patient room (nurse server)	Harrison 2S (Med/Surg) — Centralized serving 21+ patients	Harrison 2W (Oncology) — Decentralized serving 11-20 patients	Good Samaritan Corvallis — Decentralized serving 11-20	Prov Portland 8S (Neuro) — Decentralized serving 5-10 patients	Prov Portland 8N (Ortho) — Decentralized serving 5-10 patients	Good Sam Puyallup 6 — Central location serving 21+	St. Charles Redmond — Corridor cabinet serving 1-4 patients
Avg. dist to other loc	na	113	na	91	40	40	35	na	na	na	36	32	1	13
Avg. dist to closest loc	82	37	40	17	3.5	0	32.3	29	28.4	26	0	0	28.4	0
Avg dist to combined locs	82	75	40	39.2	38.2	38	33.6	29	28.4	26	14.4	12.8	11.96	6.5
Time for care	3	1.7	4	3.4	3.5	3	3.8	2.9	2.8	2.6	3.7	4.1	3.7	4
Time for documentation	3.1	2.2	4	3.4	3.5	3.3	3.6	2.8	2.9	2.6	3.7	3.9	3.6	3.8
Patient Safety	3.6	1.8	4.1	3.4	3.4	3.1	3.8	2.9	3	2.7	3.7	4.1	3.4	4

Supply locations by distance (Note: Colors are used to help express the pattern of values visually, from red for long distances to green for short distances, and the same scale for low to high ratings).

TABLE 6

	Good Sam Puyallup 4 — Centralized serving 21+ patients	Norton Brownsboro — Centralized serving 21+	Harrison 2S (Med/Surg) — Centralized serving 21+ patients	St. Charles 3 Ortho Unit — Centralized serving 21+ patients	St. Charles 4 Medical Unit — Centralized serving 21+ patients	Samaritan Lebanon — Decentralized serving 11-20 patients	Harrison 2W (Oncology) — Decentralized serving 11-20 patients	Good Samaritan Corvallis — Decentralized serving 11-20	Emory Johns Creek Hosp. — Decentralized serving 11-20	Prov Portland 8N (Ortho) — Decentralized serving 5-10	Prov Portland 8S (Neuro) — Decentralized serving 5-10	Good Sam Puyallup 6 — Patient room	St. Charles Redmond — Corridor cabinet serving 1-4	Samaritan Albany — In patient room (nurse server)
Type: central vs decent	4	4	4	4	4	3	3	3	3	2	2	1	1	1
Time for care	1.7	3	2.9	3.5	3	3.4	2.8	2.6	4	4.1	3.7	3.7	4	3.8
Time for documentation	2.2	3.1	2.8	3.5	3.3	3.4	2.9	2.6	4	3.9	3.7	3.6	3.8	3.6
Patient Safety	1.8	3.6	2.9	3.4	3.1	3.4	3	2.7	4.1	4.1	3.7	3.4	4	3.8

Supply locations by type (Note: Colors are used to help express the pattern of values visually, from red for long distances to green for short distances, and the same scale for low to high ratings).

TABLE 7

	Emory Johns Creek Hosp. — Centralized serving 21+ patients	St. Charles Redmond — Central serving 21+	Samaritan Lebanon — Decentralized serving 11-20 patients	St. Charles 3 Ortho Unit — Centralized serving 21+	Good Sam Puyallup 4 — Central ized serving 21+	Prov Portland 8S (Neuro) — Centralized serving 21+	Harrison 2W (Oncology) — Central location serving 21+	Norton Brownsboro — Decentralized serving 11-20	St. Charles 4 Medical Unit — Centralized serving 21+	Good Sam Puyallup 6 — Central location serving 21+	Good Samaritan Corvallis — Decentralized serving 11-20	Prov Portland 8N (Ortho) — Decentralized serving 11-20	Samaritan Albany — Centralized serving 21+	Harrison 2S (Med/Surg) — Central location serving 21+
Ave distance	105.6	86	75.2	70	64	62	54.7	54.4	50	41.6	40.1	28.3	28	23
Time for care	3.4	3.3	3.1	3.4	2.3	3.9	2.9	3.4	2.3	3.3	2.5	3.1	3.4	3
Time for documentation	3.4	3.3	3.3	3.4	2.3	3.6	3.3	3.3	2.4	3.3	2.7	3	3.5	3.1
Patient Safety	3.4	3.5	3.3	3.3	2.3	3.7	3	3.5	2.9	3.6	2.7	3.3	3.4	2.9

Equipment locations by distance (Note: Colors are used to help visually express the pattern of values, from red for long distances to green for short distances, and the same scale for low to high ratings).

TABLE 8

	Harrison 2W (Oncology) — Centralized serving 21+	Harrison 2S (Med/Surg) — Central location serving 21+ patients	Samaritan Albany — Centralized serving 21+ patients	Prov Portland 8S (Neuro) — Centralized serving 21+ patients	St. Charles 3 Ortho Unit — Centralized serving 21+ patients	St. Charles 4 Medical Unit — Centralized serving 21+ patients	Good Sam Puyallup 6 — Centralized serving 21+ patients	Emory Johns Creek Hosp. — Centralized serving 21+ patients	Good Sam Puyallup 4 — Central ized serving 21+ patients	St. Charles Redmond — Centralized serving 21+ patients	Good Samaritan — Decentralized serving 11-20	Prov Portland 8N (Ortho) — Decentralized serving 11-20	Norton Brownsboro — Decentralized serving 11-20	Samaritan Lebanon — Decentralized location serving 11-20 patients
Type of decentralization	1	1	1	1	1	1	1	1	1	1	2	2	2	2
Time for care	2.9	3	3.4	3.9	3.4	2.3	3.3	3.4	2.3	3.3	2	3.1	3.4	3.1
Time for documentation	3.3	3.1	3.5	3.6	3.4	2.4	3.3	3.4	2.3	3.3	2.3	3	3.3	3.3
Patient Safety	3	2.9	3.4	3.7	3.3	2.9	3.6	3.4	2.3	3.5	2.3	3.3	3.5	3.3

Equipment locations by type (Note: Colors are used to help express the pattern of values visually, from red for long distances to green for short distances, and the same scale for low to high ratings).

Impact on patient safety

The patient room location is significantly favored for safety, with corridor alcoves and satellites moderately rated, and centralized locations a distant fourth. This suggests that more time spent in or near the patient room enhances patient observation and safety.

Minimizing noise and distractions

The patient room location and corridor alcoves were favored for noise and distraction reduction, with satellites getting a moderate rating and centralized locations a distant fourth. Fewer people are present at any of the decentralized locations, creating less noise and distraction. For years, nurses have complained about the difficulty of concentrating at central nurse stations

Correlation with unit configuration

The research team sought to find design configuration correspondence within the data, as follows.

Satellite EMR locations:

- For satellites that are open visually to corridor space, five of six were rated positively (above 3.0) for patient safety. The average score was 3.4 out of possible 55. It is common for nurses to request visual access to the corridor to monitor patient activity, family and staff members seeking assistance, and to hear patient distress signals. The correlation corroborates this. Predictably, these same units received low scores for minimizing noise and distraction (only two of four positive, and average of 3.1). Intuition would tell us that the openness would invite distractions, and the data corroborates this. This poses a design challenge.
- There was no significant difference in ratings related to the number of patients served from that location.
- There was no significant difference in ratings related to average distance to patients served from that location.
- There was no significant difference in ratings in safety related to visibility of corridors from the satellite work station.

Corridor alcoves:

- For corridor alcoves that are open visually to corridor space, five of six were rated positively (above 3.0) for patient safety. The average score was 3.6 out of 5. Interestingly, these same units received high scores for minimizing noise and distraction (five of six positive, and average score of 3.4 of a possible 5). Intuition would tell us that the openness would invite distractions, but the data does not corroborate this.

- There was no correlation between size of worktop, or design of the alcove to the rating of the factors requested. Some alcoves have built-in desks; some are merely spaces for mobiles.

Centralized EMR locations:

- Only 3 of the 14 units have a central location to chart. All these units were rated with low scores. This reflects a current trend to eliminate central work areas for staff. All three also have EMR in patient rooms. Predictably, one of the three units with central EMR also has placed some computers in corridor alcoves, and although not done in a systematic consistent way, this unit's nurses rated all categories of questions higher (ranging from 0.5 to 1.0 higher in the four categories).

Collaboration space

Research question: Are certain types of collaboration spaces (central, satellite, corridor alcove, patient room) more effective than others?

Survey

Nurses were surveyed for the following:

- For each of four types of collaboration (informal, formal, shift change reporting, and physician consultation), indicate where it most often occurs. Options included patient room, corridor alcove, satellite, or centralized.
- For each type of collaboration, indicate its effectiveness (scale of 1 to 5 from "not at all effective" to "very effective").

Notes on correlation to location

Informal:

- All units averaged moderately high scores for effectiveness. All ratings were above 3.1 (positive), and 12 of 14 were 3.5 or above (between neutral and somewhat effective).
- There is no correlation of scoring to average distance from the stated location to patient. The average distance between bed and collaboration location ranged from 6 to 42 feet
- Ratings of the different locations where informal collaboration occurs were not consistently better for any one type over another. This contradicts findings in studies cited previously in this paper that show reduced communications in decentralized nurse stations, possibly because nurses are adapting to decentralization and possibly because the unique design elements are influencing the responses.

Formal care planning meetings:
- All units averaged moderately high scores for effectiveness. All ratings were 3.4 or higher (between neutral and somewhat effective).
- There is no correlation of scoring to average distance from the stated location to patient. Average distance between bed and formal collaboration location ranged from 13 to 180 feet.
- Twelve of the 14 units use a large room on the unit. For these units, there is only one place where this occurs, and as distance was not a factor in favoring shorter average walking distances, one can conclude that this room can be anywhere on the unit—preferably at the edge of the unit, to preserve valuable central real estate for other spaces.

Shift change reporting:
- All units averaged moderately high scores for effectiveness. All ratings were 3.2 or above (between neutral and somewhat effective).
- There is no correlation of scoring to average distance from the stated location to patient.
- Thirteen of 14 occur at a very decentralized location (8 at corridor alcove, 4 at patient room and 1 at satellite). This indicates a strong arrival at true decentralization of activity enabled by EMR.
- Ratings indicate no preference of one type of location over the other.

Physician consultation:
- All units averaged moderately high scores for effectiveness. All ratings were 3.2 or above (between neutral and somewhat effective).
- There is no correlation of scoring to average distance, which ranges from 0 to 180 feet, from the stated locations to patient.
- Ten out of 14 occur at a decentralized location, regardless of type of physician work space in the unit.
- Ratings indicate no preference of one type of location over the other.

Conclusions

Medications and related supplies for administering medications

The reduction of the distance between medication storage space and the patient is valuable in supporting nurses' direct patient care time, documentation time, and safety, but not the only strategy that matters. The number of patients per med room did not correlate to support for patient care goals. The medications space must be adequately sized so that all medications and related supplies can be in a single location, so nurses don't have to walk to multiple locations, which is time consuming and demoralizing. Pharmacy staff must maintain stock for decentralization to succeed.

The size of the med room has a significant impact on nurses' perception of patient safety, as shown by nurses' ratings that larger rooms and more area per bed are better for this factor.

Medical supplies

Reducing walking distance between supply storage and the patient is valuable in supporting nurses' direct patient care time, documentation time and safety, but it's not the only strategy that matters. Decentralization itself may be important, creating zones of control for nurses. The supply space must be adequately sized so all medications and related supplies can be in a single location, so nurses don't have to walk to multiple locations, which is time-consuming and demoralizing. Maintaining par stock by materials management staff is critical to success.

Equipment

The reduction of walking distance between equipment storage and the patient did not correlate to increasing nurses' direct patient care time, documentation time, and safety. This is because when equipment is decentralized, items are not returned to a given location and cannot be found reliably. This causes nurses to hunt for the item frequently in multiple locations. In this survey, single centralized rooms were rated similarly as decentralized rooms, possibly indicating that a shorter walking distance to the nearest decentralized location is offset by the frequent need to go to another equipment room. This research calls for further study to analyze which equipment should be at what level of decentralization in-room, satellite, or central. A lean process would provide an opportunity to develop a strategy, even though strategies would be different for different specializations of care (ortho, cardio, medical, oncology, etc.).

Electronic medical record (EMR) space

1. Time for direct patient care: Satellites scored highest, patient room second, and corridor alcoves third. Fixed EMR workstations scored significantly higher than mobile workstations in increasing direct patient care time. Comments from nurses noted several problems with mobile EMR (infection control, cumbersome carts, inability to carry other things when moving with EMR device).
2. Time for documentation: Corridor alcoves scored highest, satellites a very close second, and patient rooms third. This is possibly because it is preferable to be close to a patient, but slight separation from the patient and family reduces distractions when documenting.
3. Patient safety: Patient room location scored highest, corridor alcoves a very close second, and satellite third. A possible reason is that spending more time in or near the patient room enhances patient observation, and therefore, safety.
4. Minimizing noise and distractions: Patient room location scored highest, corridor alcoves a very close second, and satellite third.
5. Other factors:

    a. Corridor alcoves and satellites with open visibility are preferable to ones without for increased patient safety. However, noise and distraction are a problem with the satellites, but not for the corridor alcoves, possibly due to less crowding because there are more of these allowing the care team to spread out.
    b. Size at these decentralized locations is often inadequate. Further study is needed to determine optimum size.

Collaboration space

1. Informal collaboration: Almost all collaboration occurs at decentralized locations, and in terms of effectiveness, neither type of location (corridor alcove or satellite) is preferred consistently. The average distance to a patient does not matter in this study.
2. Formal care planning meetings: Distance does not affect effectiveness. Therefore, one can conclude that this room can be anywhere on the unit—preferably at the edge of the unit to preserve valuable central real estate for other uses.
3. Shift change reporting: Almost all occurs at decentralized locations, and in terms of effectiveness, none of the location types (patient room, corridor alcove, or satellite) are preferable consistently. The average distance to a patient does not indicate preference of one type.

4. Physician consulting: In two-thirds of units, consulting occurred at decentralized locations and one-third at central locations. In terms of effectiveness, none of the location types (patient room, corridor alcove, satellite, or central location) are preferable consistently. The average distance to a patient does not indicate preference of one type.

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