

Developing Nurse and Physician Questionnaires to Assess Primary Work Areas in Intensive Care Units

Running Title: ICU Work Area Evaluation Questionnaires

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Abstract

Objective: The objective of the study was to develop instruments for describing and assessing some aspects of design of the primary work areas of nurses and physicians in intensive care units (ICUs).

Design: Separate questionnaires for ICU physicians and nurses were developed. Items related to individual- and unit-level design features of the primary work areas of nurses and physicians were organized using constructs found in the literature. Items related to staff satisfaction and staff use of time in relation to primary work area design were also included. All items and constructs were reviewed by experts for content validity and were modified as needed before use.

Settings: The final questionnaires were administered to a convenience sample of four ICUs in two large urban hospitals.

Participants: A total of 55 nurses and 29 physicians completed the survey.

Measurements: Cronbach's Alpha was used to measure internal consistency, and factor analysis was used to provide construct-related validity. Convergent and discriminant validity were assessed through examining bivariate correlations between relevant scales/items. Analysis of variance was used to identify if the between-group member responses were significant among the four units.

Main Results: Cronbach's Alpha values for all except three preliminary scales indicated acceptable reliability. Factor analysis indicated that some preliminary scales could be partitioned

into subscales for finer descriptions of the primary work areas. Correlational analysis provided strong evidence of convergent and discriminant validity of all the scales and subscales. The significance level of F-statistics showed that the units were significantly different from each other, providing evidence of more between-unit variance than within-unit variance.

Conclusion: The questionnaires developed in the study offer a promising departure point for rigorous description and evaluation of the primary work areas in relation to staff satisfaction and use of time in ICUs at a time when the importance of such studies is growing.

Keywords

ICU staff work area evaluation questionnaires; Staff space, furniture, and equipment;

Environmental quality and controls in staff work areas; Staff privacy; Staff satisfaction; Staff use of time

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Introduction

Taking into account patient illness severity, variations in intensive care unit (ICU) outcomes can be ascribed generally to differences in individual provider skills, functioning of healthcare teams, and different attributes of ICUs (for example, 1-5). Different ICU attributes may include technology availability and level of technology integration, managerial practices, organizational culture and climate, and various design features affecting where, when, and how care is being provided. Although a significant amount of work has been done in assessing individual providers' clinical skills, healthcare team s' functioning, and organizational attributes and managerial practices in ICUs, there is a gap in the ability to measure reliably and validly the design of ICUs as work environments. To partly fill in the gap, this paper describes the construct development, reliability, and validity of questionnaires for evaluating primary work area design in ICUs.

For the purpose of the study, primary work areas in ICUs are defined as spaces where nurses and physicians spend most of their time while on duty. These areas generally do not include patient rooms where care is delivered, unless there are dedicated staff work areas within patient rooms. These areas also do not include spaces assigned to medication supply, nutrition, utility, and technology, again, if there are no dedicated staff work areas in these space. These areas in ICUs, however, include staff support functions and amenities, such as lounge space, conference room, dictation room, office storage, and kitchenette.

Primary work areas of nurses and physicians can be centralized at a single furnished area, decentralized with built-in work surfaces or work areas closer to patient rooms, and/or they can be mobile as in the cases of computers and workspaces on wheels. The primary work areas in a unit can also be a combination of centralized, decentralized and mobile areas. Concerning enclosure, individual work units within the primary areas may have variable definitions ranging from completely enclosed private individual spaces to completely open shared workstations. Some of the key design features of individual work units within the primary work areas in ICUs may include space, furniture, and equipment; environmental quality and control; and privacy regarding individual work. They may also include unit design features that support individual work and teamwork, and the locations of patient, equipment, materials, and supplies in relation to the primary work areas.

Importance of Primary Work Areas in ICUs

The primary work areas in ICUs often include numerous sensory stimuli, such as noxious smells, bright lights, frequent paging, telephone conversations and conversations among people on the floor, noisy machines, slamming doors, rolling carts and trolleys, and many other disruptive and non-disruptive clinical and non-clinical events. These stimuli exist in addition to the facts that: (a) ICU patients cannot survive without complicated life-support and monitoring systems; (b) the degree of freedom in providing critical care is limited because response to a change in patient status must be prompt; and (c) the huge amount of ICU patient data that are being gathered and monitored for managing the patient constantly challenges the limits of human abilities. All of these factors combined with various aspects of organizational and professional environment

(discussed below) make ICUs very difficult workplaces. Occupational stress, partly induced by ICUs' difficult environment, has a strong influence on the health status, work performance, and job satisfaction of ICU care providers . Working under stress is a risk factor for errors. It also contributes to burnout of ICU care providers and their move into less difficult work environments (for example, 6-13).

Despite the fact that ICU care providers work in a difficult environment, the gap between the concerns for treating the patient and the concerns for care providers' work environment is simply too large and shows no sign of decrease. The culture of ICUs generally encourages easy and quick replacement of old medical devices and/or implementation of a new treatment regimen, but discourages putting better lighting and environmental controls, more workspaces and storage, and better places for interaction and collaboration. Therefore, developing instruments for evaluating the design of primary work areas of nurses and physicians can be viewed as a first logical step toward designing supportive work environments in ICUs.

Need for Instruments to Evaluate the Design of Primary Work Areas in ICU

Many instruments are available to assess organizational and professional environments in ICUs. For example, the *Intensive Care Unit Environmental Stressor Scale (ICUESS)*, a 42-item Likert-type questionnaire, helps measure the stressfulness of commonly occurring items in the ICU environment (14). Among the 42 items of ICUESS, however, only six noise-related items can be considered relevant to staff work environment. In contrast, most items of ICUESS are psychological and medical procedure related questions mainly for ICU patients. Other existing scales measure professional and organizational environments in ICUs that may help accomplish

work in meaningful ways, help determine whether one intends to stay in a job, or help determine whether one likes the job (9, 15). Yet other scales help measure autonomy, leadership, communication, coordination, problem solving, conflict management, team cohesiveness and other organizational context traits that characterize practice environments (4, 16-21). Studies using these instruments/scales consistently emphasize the relationships between job satisfaction and performance and the perceptions of organizational and professional work environment in ICUs (example, 22-35), and illustrate the adverse influences that organizational and professional work environments have on staff stress, satisfaction and quality of patient care (example, 36-41).

In contrast, instruments to assess the design of the physical environment of ICUs are non-existent with the exception of that provided by Rashid (42). As a result, the effects of the design of primary work areas on staff in ICUs remain understudied. Rashid provides the psychometric analysis of an instrument designed to evaluate staff perception of the effects of the physical environment on patient comfort, patient safety, patient privacy, family integration with patient care, and staff working conditions in adult intensive care units. Though Rashid's scales and subscales to evaluate staff perception of their working conditions are somewhat relevant here, it should be noted that his items and scales emphasize the effects of various design features on work processes. Therefore, there is a need for instruments to assess the design of primary work areas in ICUs in terms of nurses' and physicians' satisfaction and performance (for example, use of time) in a more direct way without associating them to any process related issues.

Hypotheses Development

Hypotheses concerning the relationships between staff satisfaction and primary work areas

For the purpose of the study, satisfaction with the primary work areas can be defined as how contented an employee feels concerning the design of the physical environment of the primary work areas. Therefore, it is distinct from work or job satisfaction, and satisfaction with performance that many authors have discussed (for example, 43-48). Work or job satisfaction refers to measures of contentment with the one's duties or with the organization and one's role in it; and satisfaction with performance generally refers to measures of contentment with one's ability to perform work related tasks.

Researchers have shown that workers who are more satisfied with the design of the physical environment in their primary work areas are more likely to perform better. For example, Carlopio (49) found that employees' satisfaction with the physical environment was directly related to their job satisfaction and indirectly related to organizational commitment and turnover intention. Many other investigators also reported that the physical environment of work affects job perception, attitudes, and job satisfaction (for example, 45, 49-56). Based on the findings reported in the literature, it may be suggested that the design of the physical environment of the primary work areas may affect staff satisfaction in ICUs in the following manner:

- Better individual primary workspace features may improve individual's satisfaction with primary workspace.
- Better environmental quality and more control in individual primary work space may improve individual's satisfaction with primary workspace.
- Better privacy may improve individual's satisfaction with individual primary workspace.

- Better unit level features supporting individual and/or teamwork may improve individual's satisfaction with the design of the whole unit.
- Improved individual's satisfaction with workspace may improve individual's satisfaction with the design of the whole unit and vice versa.

Hypotheses concerning the relationships between staff time use and primary work areas

Studies suggest that unit configurations including the layout of primary work areas affect staff use of time due to walking in hospital inpatient units (57-62). Some of the important findings reported in these studies are: nursing staff in radial units walked significantly less than staff in rectangular units (4.7 steps versus 7.9 steps per minute) (58); walking accounted for 28.9% of nursing staff work time with a ranking only after patient-care activities that accounted for 56.9% of work time (61); decentralized nurse stations reduced walking time and increased patient-care time, especially when supplies were also decentralized and placed near nurse stations (62); time saved from walking was translated into patient care activities and interaction with family members (60); and the number of trips to patient rooms was fewer in radial units than in single-corridor units because nurses were able to better supervise patients visually from the nursing station; however, the average time spent with patients was the same in radial units as in single-corridor designs (59). Based on the reported findings in the literature, it may be suggested that the primary work areas may affect staff time use in ICUs in the following manner:

- Convenient location of functions in relation to primary work areas may increase staff time given to patient care and collaboration, decrease walking time in relation to activities that may not be directly related to patient care, and decrease negative effects of walking on staff use of time.

- Convenient teamwork spaces in relation to primary work areas may help reduce negative effects of walking on staff use of time.

Materials and Methods

Preliminary Questionnaires

Separate questionnaires for physicians and nurses were developed to allow for greater clarity concerning primary work areas in ICUs. Items included in the questionnaires were organized based on the following key design features of the primary work areas – space, furniture, and equipment; environmental features; privacy and interruption; features supporting individual work; features supporting teamwork; locations of equipment, materials, and supplies; staff walking time; and staff satisfaction. For guidance on the structure and content of the questionnaires other workplace design assessment questionnaires were consulted (56, 63-64). For each of the items presented in this paper, a 5-point Likert scale (strongly disagree to strongly agree) was used.

Strategies to increase reliability

Several strategies were used to increase the reliability of the questionnaires. First, each specific attribute of primary work area design were described using multiple items. Second, the questions were alternated between positively and negatively worded items to avoid response set bias by encouraging careful attention to each item of the questionnaires. Finally, where possible, items with previous evidence of relevance and reliability were used.

Expert review

The preliminary questionnaires' items were reviewed by a group of six experts representing healthcare design and critical care practice. The experts reviewed each item of the questionnaires in terms of relevance using a four-point scale (not relevant, somewhat relevant, quite relevant, and highly relevant); clarity (is the item clear? yes or no); distinctiveness (is the item distinct? yes or no); and appropriateness for the group (is the item at the appropriate reading level for the group? yes or no). Experts also had space for comments on the content review forms of the questionnaires.

Item Content Validity Index (I-CVI): An I-CVI for each item was computed based on experts' responses – ranging from '1' for agree with the content of the item to '0' for do not agree with the content of item. When every expert agrees on an item, the item has an I-CVI index of 1.0 showing universal agreement among experts. An item gets less than 1.0 when there is less than universal agreement on the item. When there are five or fewer experts, the recommended I-CVI for retention of an item is 1.00 (65).

Except for two items – “You enjoy your view outside” (CVI = 0.6) and “You have enough control over interruptions and intrusions by others in your workspace” (CVI = 0.8) – all items in the questionnaire showed universal agreement among experts. Regarding “You enjoy your view outside”, the dissenting expert wrote:

What if they do not have a window? Is the question about view, natural light or both? If both, what if they have borrowed natural light but no view? OR what if they have view but no natural light of significance?”

Because of the conceptual importance of these two items to workplace design, we opted to keep the items, determine how they perform in further psychometric analyses, and then recommend deletion or revision.

Finalizing the questionnaires

Based on the reviewers' comments on clarity, distinctiveness, and appropriate reading level, some new items were added, and some old items were modified and/or rephrased in the final version of the questionnaires. Examples of these changes include the following: (1) the lists of primary workspace types and workspace locations in the unit were extended; (2) an item on storage space to primary workspace features was added; (3) new items were added and old items were modified to better describe privacy and interruption in primary workspaces and in other spaces; (4) the list of items describing environmental features in primary workspace were extended; (5) the definition of "teamwork" was reworded for clarity, and new items describing teamwork were added; (6) the purpose of open-ended questions in the questionnaires were clarified by rephrasing "The two or three physical design features you LIKE in your unit" to "The two or three physical design features you would like to keep and why you would keep them, if given chance to redesign your unit"; and (7) in some cases, new items added to and old items deleted from the questionnaire to make them more relevant to their referents. A list of all the items included in the questionnaires is given in **Table 1**. In the table these items are grouped under a set preliminary constructs listed above. The pilot study then was conducted to garner evidence of reliability and validity of the scales.

The Pilot Study

Sample and data collection

The final questionnaires were administered to a convenience sample of four ICUs serving different patient groups. The ICUs were located in two large urban hospitals. Institutional Review Board (IRB) approval was obtained from the Human Subjects Committee of the involved institutions. Full-time and part-time ICU nurses on all shifts, physicians and intensivists who were salaried and associated with the unit, residents (where applicable), and attending physicians were invited to complete the questionnaires. Participation in the study was voluntary. Participants were recruited at staff meetings, through mail, or personal approach. The IRB-required information and cover sheets were attached to the questionnaire to ensure that participants fully understood the intent of the study and the consequences of their participation. A total of 55 nurses and 29 physicians completed the survey. **Table 2** includes some basic background information of these participants by unit.

Data analysis

In the analysis phase, Cronbach's Alpha was used to measure internal consistency of the items within a construct, and factor analysis was used to provide construct-related validity. Convergent and discriminant validity of the items and constructs were assessed through examining bivariate correlations between relevant scales/items. Analysis of variance was used to identify if the between-group member responses were significant among the four units. Any significant between-group variance would indicate that individual responses to the items and scales of the instruments could be generalized for the group these individuals represented.

Findings

Reliability: Cronbach's Alpha was used to measure the internal consistency of the items of the constructs given in **Table 1**. Using 0.70 as the commonly accepted cutoff criterion (66), Cronbach's Alpha values for all but three constructs indicated moderately acceptable to highly acceptable reliability (**Table 1**). The reliability analysis thus indicated that the items included in the preliminary constructs could be aggregated creating scales to measure these constructs. These scales with Cronbach's Alpha above the cutoff limit include a 6-item 'space, furniture, and equipment of primary work space' scale with Cronbach's Alpha of 0.86; a 7-item 'environmental quality and controls of primary workspace' scale with Cronbach's Alpha of 0.81; a 7-item 'privacy and interruption' scale' with Cronbach's Alpha of 0.87; a 7-item 'unit features supporting teamwork' with Cronbach's Alpha of 0.85; and a 3-item 'use of time in relation to walking, scale with Cronbach's Alpha of 0.79.

Factorial validity: Factor analysis (principal components with varimax rotation) was used to provide construct-related validity, specifically evidence of internal structure (67). The primary goal of the analysis, however, was to determine if the scales containing a large number of items could be partitioned into more than one subscale for finer descriptions of the ICU work environment. Using a cut-off criterion of .40 for item factor loadings and eigenvalue of 1.0 or above, factor analysis of the preliminary constructs (**Table 1**) were performed to see if these constructs had more than one internally consistent scale/s. As given in **Table 3**, the analysis revealed multiple primary components for some of the preliminary constructs, and one primary component only for the other constructs. Factor analysis of the preliminary constructs thus indicated that some of the scales with higher reliability coefficient (**Table 1**) could be partitioned

into multiple subscales for finer descriptions of the design of ICU work environments. A summary of the reliability and factor analysis of all the scales and subscale is given in **Table 4**.

Convergent validity: Convergent validity was assessed through examining correlations between and among relevant scales/items.

Concerning *Workplace design and Staff satisfaction*, as we had predicted in our hypotheses, all scales describing individual workspace level features (Scales 8, 9, 10, 11, 12, & 13 in **Table 5**) showed significant positive correlations with individual's satisfaction with primary workspace (Scale 1 in **Table 5**).

As we had also predicted in our hypotheses, all unit level features supporting individual and/or teamwork (Scales 15, 16, 17, & 18) showed significant positive correlations with individual's satisfaction with primary workspace (Scale 1 in **Table 5**).

Finally, as we had also predicted in our hypothesis, individual's satisfaction with the design of the ICU in relation to individuals' work (Scale 2 in **Table 5**) showed significant positive correlation with individual's satisfaction with primary workspace (Scale 1 in **Table 5**).

Concerning *workplace design and staff use of time*, as we had predicted in our hypothesis, 'inconvenient locations of functions' (Scale 20 in **Table 5**) showed significant positive correlation with 'walking takes away time from patient care' (Scale 6 in **Table 5**).

Concerning *workplace design and staff use of time*, as we had also predicted in our hypothesis, 'inconvenient locations of functions' (Scale 20 in **Table 5**) showed significant positive correlation with 'walking takes away time from collaborative work' (Scale 7 in **Table 5**).

All hypotheses were supported, providing strong evidence of convergent validity of the scales.

Discriminant validity: Discriminant validity was also assessed through examining correlations between and among relevant scales/items.

Concerning *workplace design and staff use of time*, we had predicted in our hypothesis that convenient location of functions may decrease walking time in the unit in relation to activities that may not be directly related to patient care. This was supported by significant positive correlation between ‘inconvenient locations of functions’ (Scale 20 in **Table 5**) and ‘you spend more time walking in your unit in relation to other activities not related to patient care’ (Scale 5 in **Table 5**).

Concerning *workplace design and staff use of time*, we had also predicted in our hypothesis that convenient location of functions may help decrease negative effects of walking on staff use of time. This was supported by significant positive correlation between ‘inconvenient locations of functions’ (Scale 20 in **Table 5**) and ‘negative effects of walking on staff use of time’ (Scale 4 in **Table 5**).

Concerning *workplace design and staff use of time*, we had further predicted in our hypothesis that convenient location of teamwork spaces may help decrease negative effects of walking on staff use of time. This was supported by significant negative correlations between two of three scales measuring teamwork spaces (Scale 17 & 19 in **Table 5**) and ‘negative effects of walking on staff use of time’ (Scale 4 in **Table 5**).

All hypotheses were supported, providing strong evidence of discriminant validity of the scales.

Validity for unit level metrics: In order to assess whether individual level data can be aggregated for unit level metrics in the present study, analysis of variance was used to identify if the between-group member responses (i.e., the variance among individuals of different units) were significant among the four ICUs included in the study. The significance level of F-statistics for most of the important scales and subscales showed that these units were significantly different from each other, providing evidence of more between unit variance than within unit variance (68). These scales include ‘space, furniture, and equipment in primary workspace’, ‘overall privacy’, ‘privacy in primary workspaces’, ‘access to equip, materials, and supplies’, ‘access to patient and people’, ‘primary and other spaces for teamwork’, and ‘primary spaces for teamwork’ (**Table 6**). This observation was further supported by the fact that these units were also distinct from each other along these scales and one more (‘environmental control in primary workspace’), when we considered nurses of these units separately (**Table 7**). However, the differences among these units were not significant for physicians only. This may be because the physician sample was too small indicating that further study needs to be done on the subject.

Discussion & Conclusion

For ICU research, there is a need for theory-based, reliable, and valid measures to assess the design of ICUs as Work Environments; therefore, to help improve the quality of staff working conditions. This study contributes to this goal in several ways. First, the metrics and scales developed in this study are grounded in theories suggesting why and how certain design features may affect staff satisfaction and use of time. Second, the study includes a comprehensive set of design related metrics and scales describing the primary work areas in ICUs. Needless to say that

the challenges presented to improve patient outcomes and the quality of patient care cannot be met without design interventions aimed at improving primary work areas. The scales presented here may help us achieve this goal. Third, the scales demonstrate acceptable reliability and convergent and discriminant validity; and, therefore, can be used in other studies related to primary work areas in ICUs without significant modifications. Finally, evidence that individual member responses, in particular ICU nurse responses, can be reliably and validly aggregated to the unit level enhances the likelihood that the scales can be used in studying a wide variety of health care organizational units and settings. Although specific referents may need to be changed to fit the particular health care organization or subunit being studied, the concepts and general content of each item and scale appear generalizable across organizational units and subunits. As a set, the measures offer a promising departure point for more rigorous analysis and evaluation of the primary work areas in ICUs at a time when the importance of such studies is growing. Of particular interest would be their use in field experiments where units are randomly assigned to experimental and control conditions based on specific interventions designed to improve the quality of staff working conditions.

While representing a promising start, the weaknesses of the instruments are clear. The fact that the instruments can be used for evaluating primary work areas only is one of these weaknesses. In future, it will be necessary to include additional items and constructs in the instruments regarding other areas in ICUs including patient rooms. Patient rooms are particularly important because direct patient care is provided here. Any inability to provide adequate patient care in patient rooms due to design problems is likely to have more impact on nurses and physicians. In future, it will also be necessary to include additional items in the instruments regarding

secondary work areas assigned to medication supply, nutrition, utility, and technology. Staff outcomes can be negatively impacted by the faulty design of these areas too.

Regarding the pilot test of the instruments, convenience sampling of the four ICUs is a major source of selection bias. ICUs often serve different patient groups using different care models. ICUs are also different in terms of unit attributes such as technology availability and level of technology integration, managerial practices, organizational and/or professional culture and climate. In future studies, more rigorous sampling methods are required to take into account the variations among ICUs for further validation of the instruments presented in this study.

Inclusion criteria used in the pilot study also needs to be revisited. Given the small number of study sites, the pilot study put much emphasis on maximizing the number of study participants. Therefore, all nurses and physicians on all shifts, regardless of age, experience, responsibilities, and time-spent in the units, were encouraged to participate in the study. As result, significant differences existed among the participants along these criteria. Given the small number of participants, it was not possible to statistically control for these variations among the participants. Therefore, a lack of control concerning participants also remains as a significant limitation of the study.

Finally, greater confidence can be placed in the metrics and scales of the instruments to the extent that they are further validated using different staff performance measures and outcomes. This study considered only two staff outcomes – namely staff satisfaction and staff use of time. Staff fatigue and stress, medical errors, staff turnover rate, and absenteeism are among the other important outcomes that may need attention in future studies. The ultimate utility of the metrics and scales of the instruments may also lie in their ability to help explain a variety of different

staff outcomes across different ICUs. A larger study, replicating the current study, would be required to help further validate the instruments, thus providing clinicians and managers with a foundation for improving the organization's ability to learn, to take corrective actions, and to improve continuously the quality of staff working conditions in ICUs.

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Table 1: Preliminary constructs, items, and Cronbach's Alpha for the items

Preliminary Constructs	Items	Cronbach's Alpha
Space, furniture, and equipment of primary work space	<ol style="list-style-type: none"> 1. The amount of space in your primary workspace fits your needs. 2. You have sufficient work surfaces in your primary workspace for your equipment and work. 3. You have enough storage space in your primary workspace. 4. Storage space in your primary workspace is secured. 5. All furniture in your primary workspace works well for your needs. 6. You can change your workspace as needed to fit your needs. 	.86
Environmental quality and controls of primary workspace	<ol style="list-style-type: none"> 1. You enjoy your view outside. 2. Your primary workspace gets enough natural light. 3. Your primary workspace has sufficient illumination for your needs. 4. You are able to control the lighting level in your primary workspace when needed. 5. You are able to control the temperature in your primary workspace when needed. 6. You are able to control air velocity/movement when needed. 7. Environmental features in your primary workspace help you do your job (documentation, charting, and/or dictation) well. 	.81
Privacy and interruption	<ol style="list-style-type: none"> 1. You feel that others cannot hear your conversations in your primary workspace. 2. You have enough privacy in your primary workspace to do your job (documentation, charting, and/or dictation) well. 3. You have enough control over interruptions and intrusions by others in your primary workspace 4. You feel that you are not interrupted by others as you work in your primary workspace. 5. You feel that you are not interrupted by others as you work in patient rooms. 6. You feel that you are not interrupted by others as you work in medication room/s. 7. You feel that you are not interrupted by others as you work in charting area/s. 	.87
Unit features supporting individual work	<ol style="list-style-type: none"> 1. You have easy access to necessary equipment, materials, and supplies. 2. When you need a computer, there is one available. 3. You can easily monitor your patients from unit workspaces. 4. Your unit has adequate space for formal team meetings. 	.63
Unit features supporting teamwork	<ol style="list-style-type: none"> 1. Your unit has adequate space for informal team meetings or interactions. 2. Meeting spaces are generally available in your unit. 3. Meeting spaces have appropriate equipment and furniture for collaborative work. 4. The people you need to work with are available in the unit when you need them. 5. Patient rooms are large enough for teamwork and collaboration. 6. Corridors are wide enough for informal interactions. 7. Centralized and/or distributed nurse stations are big enough to support team gathering if needed. 	.85

Preliminary Constructs	Items	Cronbach's Alpha
Location of equipment, materials, and supplies	<ol style="list-style-type: none"> 1. Patient rooms are close to your workstation. 2. Patient records are stored near the patient room. 3. You have easy access to necessary equipment, supplies, and materials. 4. Computers are not always located where you need them. 	.45
Satisfaction with primary workspace	<ol style="list-style-type: none"> 1. Overall, you are very satisfied with your primary workspace. 	N/A
Satisfaction with unit design	<ol style="list-style-type: none"> 1. Overall, you are pleased with the design of your unit in relation to your work. 2. Overall, the layout of your unit supports teamwork or collaboration. 	.66
Use of time in relation to walking	<ol style="list-style-type: none"> 1. You spend more time walking in your unit in relation to other activities. 2. Walking takes away from the time you would otherwise have for patient care. 3. Walking takes away from the time you would otherwise have for collaborative work (e.g., interdisciplinary rounds, working with patients and patient families). 	.79

Table 2: Basic background data of participants by unit

	Profession of participants		Gender		Number of years in the unit		Average age	
	Nurse	Physician	Male	Female	Nurse	Physician	Nurse	Physician
Unit 1	14	6	6	14	6.35	3	38.78	35.33
Unit 2	19	4	6	17	2.94	4.5	33.15	40.25
Unit 3	13	15	14	14	2	3.63	28	39.27
Unit 4	9	4	4	9	3.5	5.75	34.67	46.75

Table 3: Factor analysis of the preliminary constructs showing rotated factor loadings

Preliminary Construct	Components extracted	Items	Factor Loadings	
Space, furniture, and equipment in primary work space – 6 items	Space, furniture, and equipment in primary workspace	1. The amount of space in your primary workspace fits your needs.	.75	
		2. You have sufficient work surfaces in your primary workspace for your equipment and work.	.86	
		3. You have enough storage space in your primary workspace.	.83	
		4. Storage space in your primary workspace is secured.	.65	
		5. All furniture in your primary workspace works well for your needs.	.79	
		6. You can change your workspace as needed to fit your needs.	.74	
Environmental quality and controls of primary workspace – 7 items	Environmental quality of primary workspace	1. You enjoy your view outside.	.63	
		2. Your primary workspace gets enough natural light.	.80	
		3. Your primary workspace has sufficient illumination for your needs.	.68	
		4. Environment in your primary workspace help you do your job (documentation, charting, and/or dictation) well.	.66	
	Environmental control of primary workspace	1. You are able to control the lighting level in your primary workspace when needed.		.59
		2. You are able to control the temperature in your primary workspace when needed.		.91
		3. You are able to control air velocity/movement when needed.		.86
Privacy – 7 items	Privacy in primary workspaces	1. You feel that others cannot hear your conversations in your primary workspace.	.86	
		2. You have enough privacy in your primary workspace to do your job (documentation, charting, and/or dictation) well.	.64	
		3. You have enough control over interruptions and intrusions by others in your primary workspace	.89	
		4. You feel that you are not interrupted by others as you work in your primary workspace.	.74	
		5. You feel that you are not interrupted by others as you work in charting area/s.	.77	
	Privacy in other spaces	1. You feel that you are not interrupted by others as you work in patient rooms.		.80
		2. You feel that you are not interrupted by others as you work in medication room/s.		.89
Unit features supporting	Access to equip, materials, and supplies	1. You have easy access to necessary equipment, materials, and supplies.	.75	
		2. When you need a computer, there is one available.	.85	

Preliminary Construct	Components extracted	Items	Factor Loadings	
individual work – 4 items	Access to patient and people	1. You can easily monitor your patients from unit workspaces.		.75
		2. The people you need to work with are available in the unit when you need them.		.82
Unit features supporting teamwork – 7 items	Primary spaces for teamwork	1. Your unit has adequate space for formal team meetings.	.85	
		2. Your unit has adequate space for informal team meetings or interactions.	.89	
		3. Meeting spaces are generally available in your unit.	.83	
		4. Meeting spaces have appropriate equipment and furniture for collaborative work.	.68	
		5. Centralized and/or distributed nurse stations are big enough to support team gathering if needed.	.78	
	Other spaces for teamwork	1. Patient rooms are large enough for teamwork and collaboration.		.89
		2. Corridors are wide enough for informal interactions.		.75
Location of equipment, materials, and supplies – 4 items	Location of patient, equipment, materials, and supplies	1. Patient rooms are too far away from your workstation.	.59	
		2. Patient records are not stored near the patient room.	.50	
		3. You do not have easy access to necessary equipment, supplies, and materials.	.71	
		4. Computers are not always located where you need them.	.65	
Effects of walking on use of time– 3 items	Effects of walking on use of time	1. You spend more time walking in your unit in relation to other activities.	.61	
		2. Walking takes away from the time you would otherwise have for patient care.	.95	
		3. Walking takes away from the time you would otherwise have for collaborative work (e.g., interdisciplinary rounds, working with patients and patient families).	.94	

Table 4: Scales, primary components (i.e., subscales), items in components, and Cronbach's Alpha for both scales and subscales

Primary Scales	Components	Number of items	Cronbach's Alpha
Space, furniture, and equipment in primary workspace	1 component	6 (Factor)	
Environmental quality and controls in primary workspace	2 components	7	.81
	1. Environmental quality in primary workspace	4 (Factor)	
	2. Environmental control in primary workspace	3 (Factor)	
Overall Privacy	2 components	7	.87
	1. Privacy in primary workspaces	5 (Factor)	
	2. Privacy in other spaces	2 (Factor)	
	2 components	4	.63
	Access to equip, materials, and supplies	2 (Factor)	
	Access to patient and people	2 (Factor)	
	2 components	7	.85
	Primary spaces for teamwork	5 (Factor)	
	Other spaces for teamwork	2(Factor)	
	1 component	4 (Factor)	
	1 component	3 (Factor)	

Table 5: correlational matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1 Overall you are very satisfied with your primary workspace	1																			
2 Overall you are pleased with the design of your unit in relation to your work	.46**	1																		
3 Overall the layout of your unit supports teamwork or collaboration	0.17	.49**	1																	
4 Negative effects of walking on time use	-0.09	-.28**	-.36**	1																
5 You spend more time walking in your unit in relation to other activities	-0.02	-0.02	-.18	.61**	1															
6 Walking takes away from your time for patient care	-0.03	-.32**	-.36**	.95**	.39**	1														
7 Walking takes away from your time for collaborative work	-0.13	-.26*	-.36**	.94**	.35**	.92**	1													
8 Space, furniture, and equipment in primary workspace	.72**	.40**	0.2	-0.1	-0.02	-0.05	-0.13	1												
9 Environmental quality and control in primary workspace	.65**	.36**	.32**	-.29*	0.02	-.26*	-.38**	.58**	1											
10 Environmental quality in primary workspace	.37**	.24*	.32**	-0.23	-0.07	-0.16	-.27*	.35**	.69**	1										
11 Environmental control in primary workspace	.55**	.26*	0.12	-0.18	0.08	-0.2	-.25*	.48**	.72**	0	1									
12 Overall privacy	.66**	.46**	.27*	-0.25	-0.04	-0.23	-.32*	.58**	.70**	.48**	.50**	1								
13 Privacy in primary workspaces	.55**	.31*	0.23	-0.16	0.02	-0.11	-0.25	.42**	.60**	.35*	.47**	.81**	1							
14 Privacy in other spaces	.36**	.35**	0.15	-0.21	-0.1	-0.22	-0.19	.40**	.39**	.36**	0.2	.59**	0	1						
15 Access to equip, materials, and supplies	.37**	.32*	.35*	-.35*	-0.01	-.37**	-.43**	.29*	.58**	.43**	.37**	.36**	0.26	0.26	1					
16 Access to patient and people	.40**	.36**	0.02	-0.11	-0.06	-0.04	-0.11	.52**	.44**	.35*	.29*	.36**	.29*	0.19	0	1				
17 Primary and other spaces for teamwork	.52**	.52**	.40**	-.30**	-0.06	-.29*	-.35**	.43**	.61**	.40**	.45**	.51**	.34*	.38**	.89**	0.15	1			
18 Primary spaces for teamwork	.40**	0.21	0	-0.05	0.12	-0.07	-0.14	.34*	.31*	0.01	.40**	.31*	0.16	.28*	0	0	.40**	1		
19 Other spaces for teamwork	0.26	.42**	.44**	-.32*	-.30*	-.37**	-0.19	0.06	-0.01	0.01	0	0.11	0.08	0.06	0	0	0.16	0	1	
20 Inconvenient location of Patient, equipment, materials, and Supplies	-0.18	0	0.07	.54**	.40**	.47**	.49**	0.04	-0.06	-0.01	-0.09	-0.12	0.05	-0.27	-0.03	-0.13	-0.26	-0.24	-0.32	1

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Table 6: F-statistics (with not-so-significant statistics in bold) describing the variance for all scales among the four ICUs

	F	Sig.
Space, furniture, and equipment in primary workspace	2.6	0.06
Environmental quality and control in primary workspace	0.36	0.78
Environmental quality in primary workspace	0.25	0.86
Environmental control in primary workspace	1.53	0.21
Overall privacy	2.44	0.07
Privacy in primary workspaces	4.52	0.01
Privacy in other spaces	1.22	0.31
Access to equip, materials, and supplies	8.05	0
Access to patient and people	2.61	0.06
Primary and other spaces for teamwork	3.75	0.01
Primary spaces for teamwork	6.34	0
Other spaces for teamwork	0.22	0.88
Inconvenient location of Patient, equipment, materials, and Supplies	0.17	0.92

Table 7: F-statistics (with not-so-significant statistics in bold) describing the variance for all scales among nurses and physicians of the four ICUs

		F	Sig.
Nurses	Space, furniture, and equipment in primary workspace	3.66	0.02
	Environmental quality and control in primary workspace	0.77	0.52
	Environmental quality in primary workspace	1.93	0.14
	Environmental control in primary workspace	2.82	0.05
	Overall privacy	2.44	0.07
	Privacy in primary workspaces	4.52	0.01
	Privacy in other spaces	1.22	0.31
	Access to equip, materials, and supplies	8.05	0
	Access to patient and people	2.61	0.06
	Primary and other spaces for teamwork	4.31	0.01
	Primary spaces for teamwork	6.34	0
	Other spaces for teamwork	0.22	0.88
	Inconvenient location of Patient, equipment, materials, and Supplies	1.55	0.22
Physicians	Space, furniture, and equipment in primary workspace	0.79	0.51
	Environmental quality and control in primary workspace	0.37	0.77
	Environmental quality in primary workspace	1.11	0.37
	Environmental control in primary workspace	0.27	0.84
	Primary and other spaces for teamwork	1.07	0.38
	inconvenient location of Patient, equipment, materials, and Supplies	1.08	0.4