

EFFECTS OF ACUITY-ADAPTABLE ROOMS ON FLOW OF PATIENTS AND DELIVERY OF CARE

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- **BACKGROUND** Delayed transfers of patients between nursing units and lack of available beds are significant problems that increase costs and decrease quality of care and satisfaction among patients and staff.
- **OBJECTIVE** To test whether use of acuity-adaptable rooms helps solve problems with transfers of patients, satisfaction levels, and medical errors.
- **METHODS** A pre-post method was used to compare the effects of environmental design on various clinical and financial measures. Twelve outcome-based questions were formulated as the basis for inquiry. Two years of baseline data were collected before the unit moved and were compared with 3 years of data collected after the move.
- **RESULTS** Significant improvements in quality and operational cost occurred after the move, including a large reduction in clinician handoffs and transfers; reductions in medication error and patient fall indexes; improvements in predictive indicators of patients' satisfaction; decrease in budgeted nursing hours per patient day and increased available nursing time for direct care without added cost; increase in patient days per bed, with a smaller bed base (number of beds per patient days). Some staff turnover occurred during the first year; turnover stabilized thereafter.
- **CONCLUSIONS** Data in 5 key areas (flow of patients and hospital capacity, patients' dissatisfaction, sentinel events, mean length of stay, and allocation of nursing productivity) appear to be sufficient to test the business case for future investment in partial or complete replication of this model with appropriate populations of patients. (*American Journal of Critical Care*. 2004;13:35-45)

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A trend has become apparent in most hospitals in the United States, heightened by a severe shortage of nurses,^{1,2} a national increase in use of emergency departments, and a marked increase in hospital occupancy rates. At midnight, occupancy rates in most US hospitals hover at 80% to 95%, and by midday, when admissions and surgical volumes peak, all inpatient beds are commonly full. The resulting inability to admit new patients in a timely way, coupled with staffing shortages, plagues and stresses an already strained healthcare system.

These "bottlenecks" in the flow of patients have reached epidemic proportions and at times require tedious and even life-threatening diversions from hos-

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pitals and emergency departments because of the lack of beds or the inability to admit the next patient.³⁻⁶ These bottlenecks can delay appropriate assignments of patients to beds. Many times staff and administrators are torn between putting the next patient in the hallway of the emergency department—without appropriate nursing care and equipment—or diverting the patient to another hospital and delaying the patient's care. If the new patient is admitted during times of full occupancy, the struggle for bed control to place the patient can continue for hours or days. This article focuses on flow of patients and models of care that offer significant opportunity for solving this problem.

Background

Patient flow is defined as how hospitals transfer patients between nursing units, and it is influenced by the levels of care required and the severity of patients' conditions. Nursing units have traditionally been organized around diagnosis type, and diagnosis type is a primary predictor of bed assignments. These levels of care are influenced primarily by 3 factors (A.L.H., unpublished data, 2003):

1. the headwall capability required for multiple gases, lines, and outlets;
2. the clinical specialty skills of the nurse; and
3. historical variable reimbursement levels provided by the Health Care Finance Administration (HCFA, now Centers for Medicare and Medicaid Services).

Bottlenecks in patient flow delay assignment of patients to beds and adversely affect care.

To receive the level of care that matches their variable patterns of acuity, patients often move 3 to 6 times during their short stay. The results of these moves include missed or delayed treatments, medication errors, patients falling, and individual contact with as many as 50 to 100 caregivers or allied health professionals. An increased workload index (tasks and physical movement) is inherent in current nursing care models, and it often adds no value to patients' outcomes (A.L.H., unpublished data, 2003). Most tools for measuring acuity do not consider the effects of frequent moves of patients on caregivers or nursing units. Yet the calculation of weighted measures for patients' acuity, converted to a workload index, is how most nursing departments budget and plan the number

of nursing hours per patient day (NHPPD). Today's typical nursing unit may transfer or discharge a staggering 40% to 70% of its patients every day. A reasonable workload index is a key predictor of retention of nurses; thus, it is a chief domain of opportunity as it relates to the flow of patients and the development of new care models.

During the past 10 years, the distinction between critical care and medical-surgical care units has blurred with an ever-increasing acuity of patients, resulting in the evolution of progressive care units. Patients are admitted to progressive care units if they require short-term mechanical ventilation, infusions of vasopressors, or physiological monitoring and if they have altered levels of consciousness, altered fluid status, hypertensive crises, gastrointestinal hemorrhages, or drug overdoses. These patients ("tweeners") are at an acuity level between the acuity levels for critical care units and medical-surgical care units. Progressive care units often present a staffing challenge when nurse staffing is at a 1:2 ratio, which mirrors the NHPPD for critical care units (19-20 NHPPD). This situation challenges the efficiency and productivity of small progressive care units (4-12 beds). The number of patients who require progressive care (also termed "low-risk monitored patients") has increased sharply in the past decade. Because this growth is consistent and measurable, it suggests the need for additional and flexible rooms for patients who require progressive care. A possible solution is acuity-adaptable rooms.

The problem of patient flow and hospital capacity is multifaceted and is externally driven by several key factors: an aging population; migration of short-stay (less acutely ill) patients from tertiary hospitals; new technologies; and compressed, higher acuity lengths of stay. Small, incremental improvements can be achieved from targeting bed placement, communication, and housecleaning efficiency. However, for long-term success and future delivery of care, the medical-surgical specialty part of patient flow must be examined.

Nursing units transfer or discharge 40% to 70% of their patients every day.

Facilities are increasingly unable to meet the demand for beds in progressive care units. When the beds in the progressive care unit are full, a patient with mid-level acuity will be placed in a bed in a critical care unit. A significant number of beds in critical

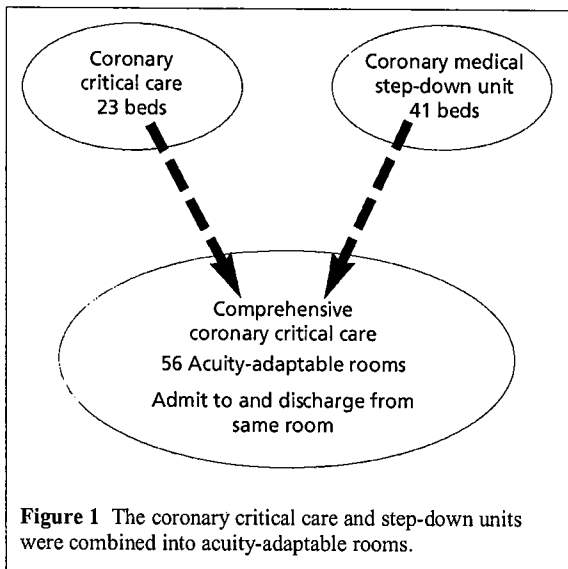


Figure 1 The coronary critical care and step-down units were combined into acuity-adaptable rooms.

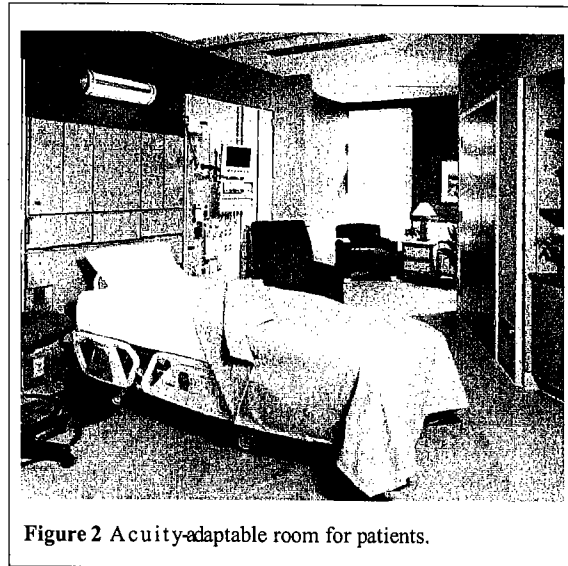


Figure 2 Acuity-adaptable room for patients.

care units are often occupied by patients who are low risk but require monitoring according to the criteria of the Acute Physiology and Chronic Health Evaluation.⁷ The difference between the NHPPD of 19 to 20 in critical care units and the NHPPD of 5 to 6.5 in medical-surgical units is significant, and it is a primary factor in physicians' decision making about placement of patients. Also, because it is a constant concern for nursing practice and patients' safety when high-acuity patients are placed in general medical-surgical units, physicians and nurses will opt to place patients in the beds designated for patients with higher acuity. The resulting short stays and multiple transfers—or even discharges directly to home—contribute to increased workload index for critical care staff and poor utilization of scarce resources (human and fiscal). Moreover, the lack of availability of beds in a critical care unit can pose safety concerns: delays in placement of patients and referrals or transfers of high-acuity patients.

This phenomenon became the driving force behind our demonstration project, which we named Cardiac Comprehensive Critical Care (CCCC). A room with acuity-adaptable headwalls was developed to provide an improved care environment for patients who required progressive care.

Methods

Literature Review

The search engine OVID was used to search MEDLINE (1996-2003). Keywords used were acuity-adaptable rooms, patient transfers, emergency room diversion, intensive care unit utilization, patients' rooms, facility design and construction, patient care

management, bed occupancy, comprehensive care, patient flow (organizational efficiency), length of stay (trends), and integrated delivery of healthcare.

Two studies^{8,9} at British Columbia Women's Hospital indicated that satisfaction of staff members and patients with the hospitalization experience was greater when patients remained in a single room throughout the entire stay (for low-risk obstetric admissions). An increase in satisfaction was indicated in the following areas: provision of information and support, physical environment, nursing care, education of patients, assistance with infants' feedings, respect for privacy, preparation for discharge, and increased overall satisfaction with the work environment. Results of additional studies¹⁰⁻¹⁷ support these findings. Furthermore, Besserman et al¹⁰ tested use of an alternative flexible approach to traditional fixed intermediate and intensive care to minimize transfers of patients. Direct admissions to a flexible intermediate care unit increased, with no overall change in admissions to the intensive care unit. Fewer patients needed conventional mechanical ventilation, and more patients in both units (intermediate and critical care) could be treated with noninvasive ventilation. In addition, length of stay and mortality decreased, and some cost savings resulted from the decrease in the number of transfers. Further, allowance of flexible monitoring demonstrated a decrease in length of stay and saved one hospital more than \$3 million in the first year of implementation.¹⁰

Planning for Evidence-Based Design

Discussion about the need for this type of unit began during the mid-1990s, when the Methodist

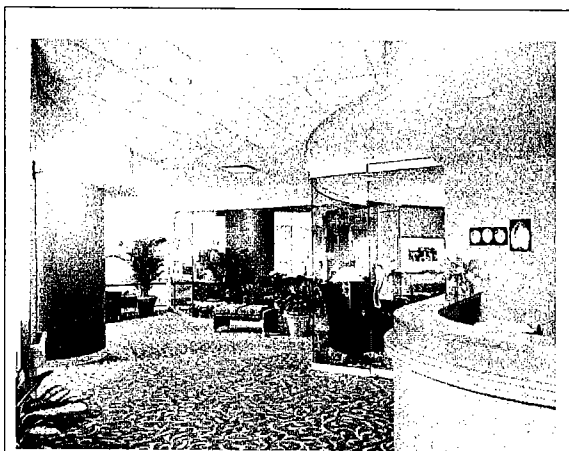


Figure 3 Welcoming area where family members can gather.

campus of Clarian Health, Indianapolis, Ind, had an urgent need to plan for additional bed capacity, because of consolidation. Awareness of the problem of patient flow, which was occurring more often, was keen. Methodist Hospital had 2 floors of shell space for a nursing unit, a situation that presented a unique opportunity to combine current knowledge with a long-term, futuristic view of models for delivery of progressive and critical care.

The framework for team planning and the process used were interdisciplinary. A blend of continuous quality improvement principles and systems thinking was integrated with evidence from the literature. In order to proceed with the design process, the clinicians' perspectives and results from 2 studies on work process and patient flow (A.L.H., unpublished data, 2003) were incorporated into the process. The first study was a 1000-hour video of time and motion on a medical-surgical unit that simultaneously detailed all activities in the patient's room, the hallway, and the nursing station. The second study was a direct observational study of transport of patients. From these studies, it was clear that our weaknesses paralleled those outlined in the "Background" section of this article. The caregiver environment was addressed: workload index (including transfers of patients), ergonomics such as reach and distance to perform care tasks, and equipment location. An expert on designing environments that promote healing worked with staff on site to improve lighting, colors, air quality, warmth, and patients' privacy.¹⁸ Focus groups of patients were used throughout the design process.

Discussions were held with the Joint Commission on Accreditation for Healthcare Organizations and the state department of health because some stan-

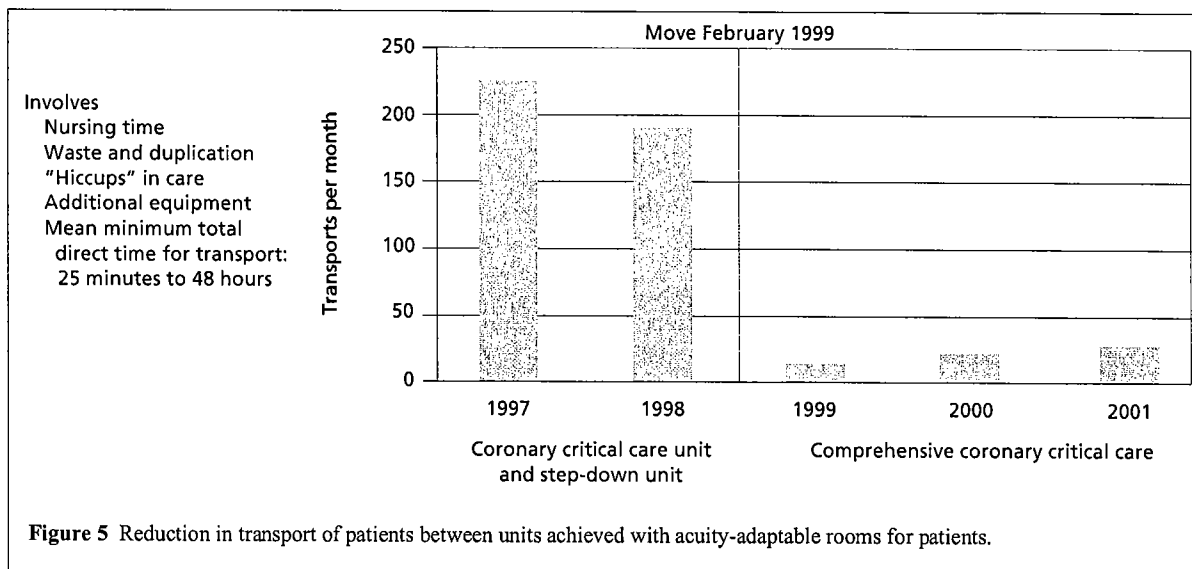


Figure 4 Decentralized nursing/caregiver work area for electronic and/or paper entry.

dards would be challenged by the new design. An unanticipated barrier was the definition of critical care in the HCFA guidelines. These guidelines define critical care and guide the billing standards that create limits about charging different amounts for the same bed according to the type of care provided. Variable rates generally cannot be used for beds designated for critical care. The language defining critical care created a barrier to the improvements. Ultimately, a HCFA appeal process was used to legitimize standard criteria for variable billing because patients would not be transferred from the acuity-adaptable rooms. Specific acuity criteria for variable rate billing and written physicians' orders for discharging from one level of acuity to another were the final solution.

Our basis for choosing a population of patients included consolidation needs, characteristics of the bottleneck, and our need for a population with a fairly predictable clinical course. Consequently, the coronary critical care unit and its step-down medical unit were selected (Figure 1). Once the population of patients was selected, the project team worked to solidify the overall design aims of the CCC's demonstration project:

- eliminate resource waste (caregiver and fiscal),
- improve the caregivers' work environment and personal satisfaction,
- create an exceptional patient care experience,
- provide a balance with characteristics of a healing environment, and
- support future delivery of care while solving problems with the flow of patients.



First, we needed to shift indirect time back to the nurses and patients' care by reducing the steps necessary for nurses to obtain supplies, reduce transfers of patients, rework the care delivery model, minimize delays for placement of patients and waits in holding areas, eliminate equipment duplication, maximize technology for efficiency, and have information for patients and caregivers readily available at the point of care.¹⁹ Second, the development of a preeminent healing environment and experience for patients was a high priority.²⁰⁻³⁰ In order to provide rest and comfort for patients and their families and significant others and prevent clinical complications, additional space was planned for a family area.^{31,32} Finally, a high-tech, user-friendly approach to the education of patients and their families was developed to encourage prevention and self-care.

The Final Design

The CCCC opened in the fall of 1999 as a preeminent care unit balanced with healing characteristics. The unit features 56 acuity-adaptable rooms (28 per floor), with an additional treatment room on each floor. The CCCC provides a warm atmosphere without sacrificing the nursing staff's access to technological and medical needs. A national demonstration model within 3 years, the CCCC was recognized by the American Association of Critical-Care Nurses, the Society for Critical Care Medicine, and the American Institute of Architects as the critical care award winner. It has already established new standards for high-tech, holistic care.

Each room occupies 36 m² (400 ft²) and consists of 3 main areas: the family zone, the patient zone, and the caregiver zone. The family zone offers many new features: a chair-bed for nighttime visits, a refrigerator, a computer hookup, voice mail, and a television/videocassette recorder. Each oversized room also includes 13.5 m² (150 ft²) of family space. Waiting areas are designed to provide more soothing features, such as an indoor garden, an aquarium, a kitchenette, and small lockers. Additional features for patients and their families in the unit include customized educational kiosks and computer-based education. The content orients patients and their families to the unit and provides a source for education individualized to each patient.

Acuity-adaptable rooms were designed so that progressive and critical care could be provided in the same setting.

Technologically, the rooms are state of the art. All equipment and supplies required for the medical needs of critical care patients are easily accessible, including transforming (acuity-adaptable) headwalls and advanced computer technology located directly on the patient's bed, so staff can record body weight and other vital data without disturbing the patients. Patients are admitted and discharged from the same room (Figure 2).

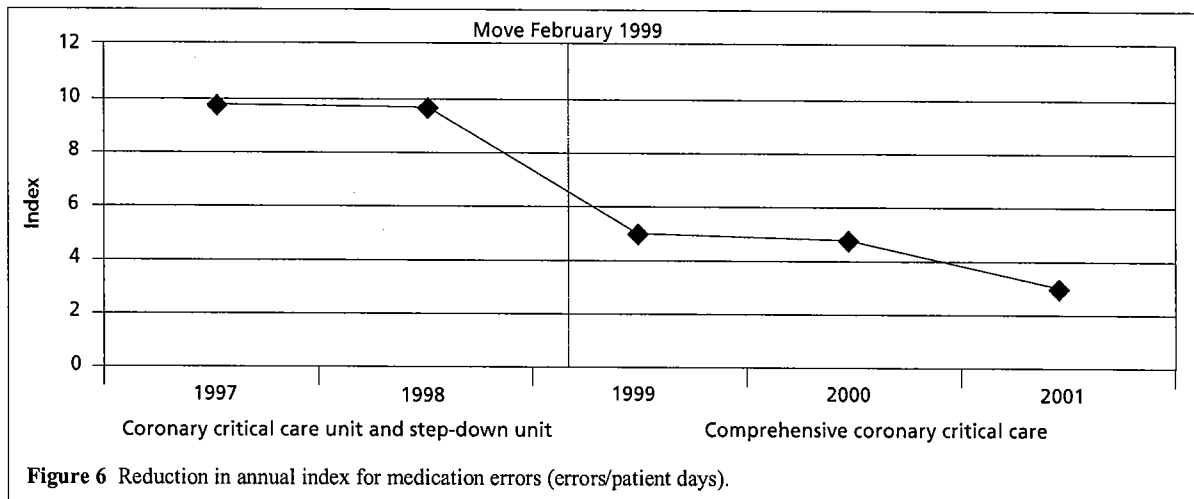


Figure 6 Reduction in annual index for medication errors (errors/patient days).

The staff zone offers similar conveniences (Figures 3 and 4). Because most of the distance traveled by nurses in a typical unit consists of travel back and forth to the nursing station,^{3,14} we arranged for necessary supplies to be in each patient's room. Nursing stations with computer access and servers for supplies are decentralized. Additional workspace for caregivers is located just outside each patient's room. The design of the corridor allows emergency equipment such as defibrillators to be hidden behind doors.

Additional features for staff include a computerized education center for uninhibited access to information and training materials. Because of the open nature of the unit and its 24-hour visitation policy, staff have a lounge for relaxing, a private shower, a bathroom, and lockers. Other features include convenient supply rooms and a personal paging and identification tracking system that pinpoints staff locations.

Data Collection

In order to assess the impact of this acuity-adaptable demonstration project, various clinical and financial measures were measured before and after the move. A list of 12 questions was formulated as the basis for inquiry, 7 are reported on here. Two years of baseline data were collected from the Transition System, Inc (Vanderbilt University Medical Center, Nashville, Tenn; *International Classification of Diseases, Ninth Revision*/diagnosis-related groups, demographics, admission/discharge/transfers, charge/cost, complication codes and case-mix index severity), QuadraMed (nursing acuity; QuadraMed Corp, Reston, Va), and the hospital's data base of sentinel events before the move. The data obtained before implementation of the new design were to be compared with 3 years of data collected in

the months after implementation. The 7 areas of inquiry were as follows:

1. Will the CCCC patients have fewer complications (adjusted for severity) when compared with a baseline cohort of matched patients? Will the mortality index change?
2. Will the sentinel event index rates decrease within the CCCC (eg, falls, medication errors, complaints)?
3. Compared with baseline data, will satisfaction increase among clinicians as a result of key interventions (technology, environment, care delivery model)? Will the measures change over time (3, 6, 12, 24 months)?
4. Will patients' satisfaction levels be higher than they were in the baseline data set?
5. Will recruitment and retention of nurses improve in a CCCC environment?
6. What market impact can be measured or quantified with payer, patient, physician, or patient's family? Would patients recommend the CCCC to others?
7. Compared with the baseline data, will the costs of labor (direct, nondirect, and fixed) be reduced with the environment, technology, and care delivery model?

Related variables such as case mix index and patient acuity, which could affect the analysis of outcome measures, were carefully compared to ensure that beneficial and adverse changes from the baseline could be detected.

Two sentinel events (ie, medication errors and patients' falling) were tracked continuously because of their commonality and their potential adverse effect on quality of care and patients' outcomes. In order to ensure that reliable measures were used in the comparison, a monthly index was used to track rates before and

