

The Use of Single Patient Rooms versus Multiple Occupancy Rooms in Acute Care Environments

Executive Summary

A. Review and Analysis of the Literature

An extensive review of literature in the areas of healthcare design, construction and operating cost, hospital management, staff efficiency, infection control and patient outcomes was conducted in order to identify advantages and disadvantages of single versus multiple occupancy patient rooms. The literature search revealed that many articles on the relationship of design to healing and innovations in hospital design are dated 1980 and later, so this timeframe was chosen for the systematic journal searches. However, relevant articles dealing with room occupancy and patient care issues, and dated earlier than 1980 were also included in the review.

The research questions that guided the literature review were:

1. What are the differences in first cost, operating cost, energy costs and efficiency of management and care delivery in single and double occupancy patient rooms in acute care settings?
2. What are the advantages and disadvantages in disease control and falls prevention in single versus double occupancy rooms in acute care settings?
3. What are the therapeutic impacts (socio-behavioral issues of patient privacy, social interaction and daily functioning) of single versus double occupancy hospital rooms?

The articles, book chapters and reports reviewed were initially divided into four categories: a) First and operating cost of hospitals; b) Health care facility management and hospital design; c) Disease control and falls prevention; and d) Relationship between healing and environment. An in-depth review of the literature revealed that articles in the “Healthcare facility management and hospital design” and the “Therapeutic impacts: Relationship between healing and environment” categories had a significant overlap of foci and issues. Consequently, findings in these two categories were combined. The final three categories [i.e., a) cost, b) infection control and falls, and c) hospital design and therapeutic impacts] were utilized as a framework to analyze the literature, which is presented in the integrated summary document, “*A Review and Analysis of the Literature.*” The findings from the literature review are also presented in a chart format in order to provide information in a concise manner (*Appendix A - Charts*). In addition, an annotated bibliography providing a summary of key issues from each article or chapter was developed (*Appendix B - Annotations*). A list of the articles, book chapters, and reports reviewed is provided in *Appendix C – Bibliography*. Based on the feedback from CHER Research Council on the interim report, several additional pertinent articles have been included in this review and analysis since the time of submission of the interim report. Moreover, sections of the document have been reorganized and/or fine-tuned based on the council’s comments.

The following chart illustrates the number of empirical and non-empirical articles or book chapters (total number: 222) reviewed in each of the three final categories:

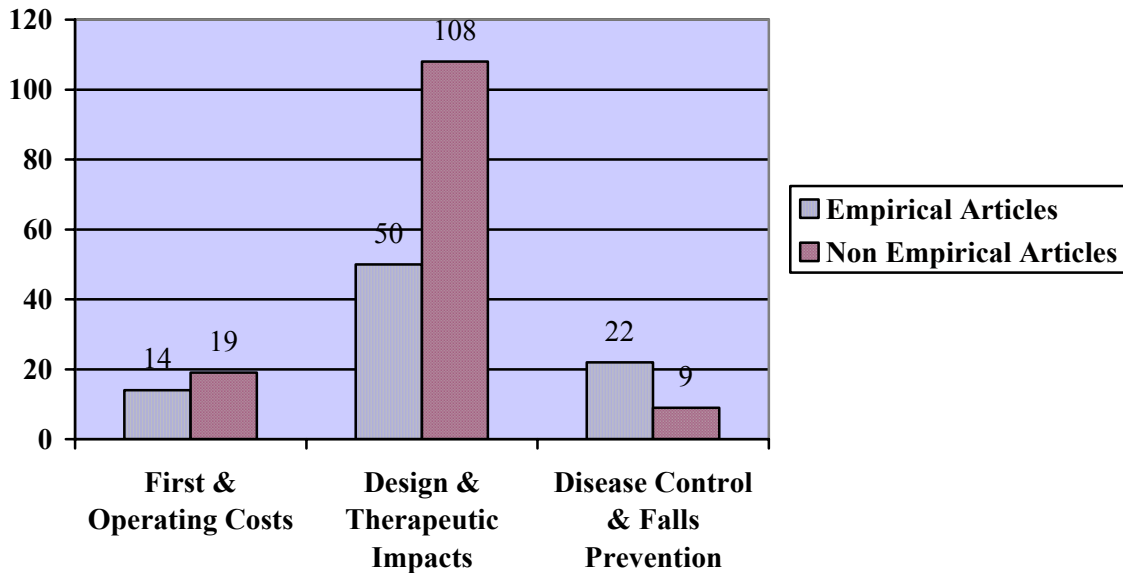


FIGURE 1: The number of empirical and non-empirical articles reviewed under specified categories

Key Findings:

Private rooms are the trend in hospital planning and design. The advantages of single-occupancy rooms are cited as improvements in patient care, a reduction in the risk of cross infection, and greater flexibility in operation. However, it is important to view and interpret the benefits of single-occupancy rooms within the context of patient care issues, other environmental changes and management policy changes in order to bring about desired and sustainable outcomes.

First and operating costs

- Literature focusing on comparative first costs for single and multi-occupancy rooms is scarce. The limited number of articles exploring the relationship between first costs and operating costs indicates that operating costs are proportionately more than the capital cost of hospitals, and this is true even for cost estimates within the first three years of construction.
- Operating costs are reduced in single patient rooms compared with multi-occupancy rooms due to reduction in transfer cost, higher bed occupancy rates and reduction in labor cost. However, this cost reduction can be better achieved when conversion to single room is paired with other healing environment design

principles. Cost savings because of reduction in transfers is particularly applicable with acuity-adaptable rooms (Hill-Rom, 2002; Ulrich, 2003).

- Even with higher first or unit costs of construction, furniture, maintenance, housekeeping, energy (e.g., heating and ventilation) and nursing, single occupancy can match the per diem cost of multi-bed rooms because of the higher occupancy rates (Bobrow & Thomas, 2000; Delon & Smalley, 1970).
- A patient's length of stay is associated with hospital costs. Research demonstrates that patients' length of stay in private rooms is shorter, which in turn reduces costs (Anonymous, 2000; Hill-Rom, 2002).
- In comparison to multi-occupancy rooms, medication errors are reduced in single-occupancy rooms, resulting in reduced costs (Anonymous, 2000; Bilchik, 2002; Bobrow & Thomas, 2000; Hill-Rom, 2002; Morrissey, 1994).

Infection Control and Falls Prevention

Infection Control

- Infected patients or patients highly susceptible to infections need to be isolated in private rooms with proper ventilation systems and barrier protections in order to stop infection from spreading or to reduce the possibility of development of new infections. (Anderson et al., 1985; Muto et al. 2000; O'Connell & Humphreys, 2000; Sehulster & Chinn, 2003).
- Prolonged hospitalization is a risk factor for hospital-acquired infections. Additionally, intra-hospital spread of infection may result from patients being transferred to more than one ICU or more than one floor during their hospitalization.
- Patients length of stay in hospitals and cost is increased due to nosocomial infection (Zhan & Miller, 2003; Press Ganey Associates, 2003; Pittet, Tarara & Wenzel, 1994). Ongoing research is demonstrating that nosocomial infection rates are low in private rooms with proper design and ventilation systems (The Center for Health Design, 2003).
- Caution must be used when interpreting results from infection control literature, because the findings and recommendations are often based on retrospective investigations of infection outbreaks in particular settings and are tailored towards those settings. They may or may not be applicable to other settings.

Patient Falls

- Patients who require constant supervision (as in the case of frail and/or delirious patients) are more likely to fall in hospitals; multi-occupancy patient rooms with increased surveillance may be more appropriate for these patients (Jones & Simpson, 1991; Sutton, 1994; Tutuarima et al., 1997).
- Most falls occur in patient rooms, among elderly patients, and when patients are alone or while attempting to go to the bathroom. (Hendrich et al., 1995; Langer, 1996; Pullen, Heikaus, & Fusgen, 1999). However, if provision is made for family members in patient rooms, falls may be reduced due to assistance from family. It is easier to accommodate family in private rooms than in semi-private rooms (Ulrich, 2003).

Health care Facility Management, Hospital Design and Therapeutic Impacts

- Single-occupancy rooms increase patients' privacy, which provides patients with control over personal information, an opportunity to rest, and an opportunity to discuss their needs with family members and friends. The number of patients in a room, the presence of visual screening devices, the location of the bathroom, and the placement of the patient's bed all impact privacy (Bobrow & Thomas, 1994; Burden, 1998; Morgan & Stewart, 1999).
- The influence of room occupancy on type of pain medication usage is mixed. Some researchers discovered that patients in private rooms were more likely to use narcotics than were similar patients in semi-private rooms. This may be due to decreased environmental stimuli in private rooms. Whereas, others have demonstrated that pain medication intake is less in single occupancy rooms. (Dolce et al., 1985; Lawson & Phiri, 2000).
- It is claimed that health care professionals have more private, and in many cases, more thorough consultation with patients in single rooms than with patients in multi-occupancy units (Ulrich, 2003). Research in this area of patient confidentiality and patient consultation is limited.
- Mixed results were obtained in studies and surveys of patients' preferences for room design. The majority of patients prefer single rooms because of greater privacy, reduced noise, reduced embarrassment, improved quality of sleep, opportunity for family members to stay, and avoidance of upsetting other patients (Douglas, Steele, Todd, & Douglas, 2002; Kirk, 2002; Pease & Finlay, 2002; Reed & Feeley, 1973).
- Patient stress can be reduced if preoperative patients are assigned to rooms with postoperative or non-surgical patients (Kulik, Moore, & Mahler, 1993). Multiple occupancy rooms are associated with lack of privacy, higher noise level and sleep disturbance (Hilton, 1985, Ulrich, 2003).
- *Universal rooms* or *acuity adaptable rooms* are a current trend in design, especially in hospitals that are promoting patient-centered care and family participation in the patient's healing program. These rooms are all private rooms. Results from a limited number of studies have indicated that medication errors, patient falls and procedural problems may be reduced in acuity adaptable rooms (Bobrow & Thomas, 2000; Gallant & Lanning, 2001; Hill-Rom, 2002; Spear, 1997). However, these results may be specific to the particular institutions studied. More detailed study with examples from multiple hospitals is required before drawing specific conclusions.
- Sources of stress for patients are: perceived lack of control, lack of privacy, noise, and crowding (Shumaker & Pequegnat, 1989). Excess noise can lead to increased anxiety and pain perception, loss of sleep, and prolonged convalescence (Baker, Garvin, Kennedy, & Polivka, 1993; Cys, 1999; Hilton, 1985). Single rooms often afford more privacy, reduction of noise and less crowding. Control is greater in private rooms, as patients can adjust settings according to their needs (Shumaker & Reizensten, 1982).
- Music can also help reduce patients' stress. Patients can listen to music in private rooms without disturbing their roommates (Cabrera & Lee, 2000).
- Crowding can contribute to higher blood pressure. The use of private rooms often minimizes the patients' sense of crowding (Baum & Davis, 1980; D'Atri, 1975).

These key findings are summarized in Table 1:

Category	Room Occupancy	Issues & Findings
<u><i>COST</i></u>	Single-Occupancy Room	<ul style="list-style-type: none"> ▪ Operating costs ↓ ▪ First costs ↑ ▪ Occupancy rates ↑ ▪ Length of stay ↓ ▪ Medication errors & costs ↓
	Multi-Occupancy Room	<ul style="list-style-type: none"> ▪ Operating costs (inconclusive) ▪ First costs ↓ ▪ Occupancy rates ↓ ▪ Length of stay ↑ ▪ Medication errors & costs ↑
<u><i>INFECTION CONTROL AND FALLS</i></u>	Single-Occupancy Room	<ul style="list-style-type: none"> ▪ Rate of nosocomial infection ↓ ▪ Patient transfers ↓ ▪ Patient length of stay ↓ ▪ Infections in burn patients ↓ ▪ HCV transmission between patients ↓ ▪ Transmission of hospital-acquired diarrhea ↓ ▪ Falls in patients requiring supervision ↑ ▪ Falls in elderly when provisions are taken ↓
	Multi-Occupancy Room	<ul style="list-style-type: none"> ▪ Isolation for infected patients (inconclusive) ▪ Infections when patients are transferred ↑ ▪ Transmission of hospital-acquired diarrhea ↑ ▪ Patient length of stay ↑ ▪ Access to bathrooms ↓ ▪ Falls in patients requiring supervision ↓ ▪ Falls in elderly when provisions are taken ↓

TABLE 1: Categories, issues, and findings related to single versus multiple occupancy patient rooms based on the literature review

Category	Room Occupancy	Issues & Findings
<u>HOSPITAL DESIGN & THERAPEUTIC IMPACTS</u>	Single-Occupancy Room	<ul style="list-style-type: none"> ▪ Privacy ↑ ▪ Pain medication (inconclusive) ▪ Patient consultation with physician (inconclusive) ▪ Patient preference for room design (inconclusive) ▪ Noise level ↓ ▪ Sleep disturbances ↓ ▪ Acuity-Adaptable rooms (inconclusive) ▪ Patient satisfaction ↑ ▪ Patient control ↑ ▪ Crowding ↑ ▪ Stress reduction through music ↑
	Multi-Occupancy Room	<ul style="list-style-type: none"> ▪ Privacy ↓ ▪ Pain medication (inconclusive) ▪ Patient consultation with physician (inconclusive) ▪ Patient preference for room design (inconclusive) ▪ Benefit of roommates (inconclusive) ▪ Noise level ↑ ▪ Sleep disturbances ↑ ▪ Patient satisfaction ↓ ▪ Patient control ↓ ▪ Crowding ↑ ▪ Stress reduction through music ↓

TABLE 1(Cont'd): Categories, issues, and findings in regards to single versus multiple patient rooms based on the literature review

B. Comparative Assessment of “First Costs” of Single versus Double Occupancy Residents’ Rooms

Based on consultations with Mahlum Architects and Davis Langdon Adamson (Construction Cost Planning and Management firm), the focus of first costs comparison has been expanded from patient rooms and adjacent corridors to include the associated support service areas in the nursing units. Mahlum Architects has assisted us in identifying several nursing unit floor plans with various configurations. However, most of these plans reflect either all single patient rooms or a mix of single and double rooms in the nursing units. Based on the analysis by Davis Langdon Adamson on multiple nursing unit floor plans of various configurations, it is evident that gross area per patient is significantly larger for single patient rooms than for double patient rooms. Most of the other building components correlate to area, rather than patient count. This leads to the conclusion that for the purpose of this study, single patient rooms can be reasonably evaluated based on area per patient.

A dual approach has been taken in comparative first cost assessment between single and double occupancy rooms. The first approach is an overall comparative estimation completed by Davis Langdon Adamson based on ten nursing unit floor plans (see *Appendix D – Floor Plans*). Because none of the nursing units consisted of only double patient rooms, the grossing factor was calculated for single patient room floors and for mixed (double and single) room floors. Gross floor area per bed was calculated by multiplying the square footage of the room by the grossing factor for that floor plan type (either single patient or mixed). Based on the analysis of the nursing floor plan samples, gross area per bed can be considered a reasonable indicator of cost per patient for building construction. The cost for construction of a typical patient nursing tower, based on cost analysis of these and other recently built hospitals, is about \$285 per square foot for both types of floor plan.

Two additional floor plans have been analyzed, resulting in a total of ten nursing unit floor plans included in this final cost model. The overall conclusion was not significantly altered by addition of the two hospitals. Using the construction cost and the values for gross floor area per patient calculated, the cost per patient for the two floor plan types (based on ten different nursing units) was as follows:

- \$182,400 per patient – single patient room floor plans
- \$122,550 per patient – mixed room floor plans

Typical Cost Models for Hospital Nursing Tower Construction for single and double rooms are provided in document “*First Cost Overview Analysis*.”

The second approach provides a cost model that replaces the single rooms of a nursing unit with double rooms. This analysis was done by the quantity surveyor firm, BTY Group, based on one particular nursing unit plan (Swedish Medical Center, Seattle). In

this approach, it was assumed that the total patient room areas and half of the corridor areas immediately adjacent to those patient rooms would be reduced by 20%, while the core support service areas would remain the same as that required for the one-bed option in the floor plan. This cost model includes all direct and indirect building construction costs, and excludes items such as legal fees, professional fees and disbursement, site work, etc. This approach (based on one example) yielded the following cost comparison:

- \$153,000 – single patient room option
- \$134,000 – double patient room option
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See the document “*Comparative Cost Study*” for the report on this approach.

Nursing unit floor plans analyzed in this cost modelling are as follows:

- Evergreen Hospital, Kirkland. East Wing, 5th floor
- University of Washington Medical Center, Seattle. Wing EC/EB, 4th floor
- Swedish Medical Center, Seattle. Southeast Tower, 9th floor
- Providence Newberg, Oregon. 2nd floor
- Evergreen Hospital, Kirkland. unidentified floor
- San Joaquin General Hospital, California. Med Surg, 2nd floor
- VA Menlo Park, California. Psychogeriatric floor
- University of California at Davis Medical Center, Davis. Davis Tower, 14th floor
- St Luke’s Medical Center, Milwaukee, Wisconsin.
- Valley Presbyterian, Van Nuys, California.

C. Pilot Study on Comparative Assessment of Operational Costs and Patient Care Issues in Single and Multiple Occupancy Patient Rooms

This empirical component of the research documented, comparatively analyzed and synthesized information on use, efficiency and suitability of single and double occupancy med-surgical patient rooms in four hospitals in the Pacific Northwest. We conducted structured interviews with administrators and staff in the following four hospitals: Evergreen Hospital Medical Center, Kirkland, Washington; Swedish Medical Center-First Hill, Seattle, Washington; University of Washington Medical Center, Seattle, Washington; and Providence Medical Center, Portland, Oregon.

Brief descriptions of the hospitals:

Swedish Medical Center-First Hill: Swedish Hospital is the Northwest's largest, most comprehensive medical center, with three campuses: Seattle's First Hill, Swedish Medical Center/Providence and Swedish Medical Center/Ballard. Swedish Medical Center-First Hill is the flagship campus, with 697 beds.

Evergreen Hospital Medical Center: Evergreen Healthcare is a community-based health care organization serving more than 400,000 people in the Northwest. Evergreen Hospital Medical Center is a 244-bed acute care hospital in Kirkland, Washington.

University of Washington Medical Center: The University of Washington Medical Center is a comprehensive medical care facility. It is rated among the top dozen medical centers in the United States. Number of beds is 450. Inpatient admission in 2002 was 16,517, and total operating expenses were more than \$436 million.

Providence Portland Medical Center: The Providence Portland Medical Center is located in the Portland metro area, with 483 beds and admissions of 22,646 in 2000.

Data Collection

We developed two questionnaires to gather data on staffing, patient care issues and operational costs. The first questionnaire focused on hospital background information, staffing patterns in nursing units, comparative assessment of single versus double patient rooms and some operating cost issues. This was used with an appropriate administrative staff member in each of the four hospitals. The second questionnaire focused primarily on comparative assessment of single versus double patient rooms in terms of patient care and staff efficiency. This questionnaire was used with frontline nursing staff (e.g. nurse managers, charge nurses, nurse aides and other health care personnel) at each hospital. There is some overlap of the questions on the two questionnaires. We believed that it was important to gather multiple viewpoints (from both administration and nursing unit staff members) on certain issues of advantages and disadvantages of single versus double patient rooms.

In order to identify relevant issues and variables for a comparative assessment of operating costs with an emphasis on staffing and maintenance costs, we consulted with several administrative and nursing staff members at those four hospitals either in person or over the telephone. It became apparent that there is no systematic built-in mechanism for documenting staff efficiency and patient care factors, and their associated operating cost figures in these four hospitals. For example, although anecdotal experience indicates that considerable time is spent on patient transfers, there is no existing data on the actual time spent on the related tasks at the hospitals. Given the scope in time and financial resources of this current study, we gathered experience-based data on these issues. We believe that in order to fully examine the factors that have relevance for operational costs associated with single and multi-occupancy rooms (e.g., reduced transfers, effect of single rooms on infection rates, easier surveillance), an expanded study with a specific focus on these issues should be considered in the future.

Key Findings

Data from the semi-structured questionnaires was analyzed using SPSS for Windows software. Descriptive statistical analysis was performed on the quantitative data to provide comparative assessment on single versus double patient rooms. Participants represent various levels of nursing staff. The findings need to be viewed within the context of the limited sample size of this pilot study (Nursing staff N=73; Administrative staff N=4). In comparing single- versus double-occupancy rooms, it is evident that nurses clearly favored single-occupancy rooms. Most of the participants responded more favorably for single rooms than for double rooms on the majority of the fifteen categories in the comparison questions. The most noticeable categories of positive assessment for single rooms include: flexibility for accommodating family, suitability for examination of patients by health care personnel, patient comfort level, patient recovery rate, less probability of medication errors, and less probability of diet mix-ups.

- The respondents rated many environmental characteristics of single patient rooms as helpful. These included the layout of the room (47 percent), the availability of space in rooms (49 percent), the arrangement of furniture (47 percent), privacy (89 percent), and space for family members (51 percent).
- Double-occupancy rooms were thought to be somewhat helpful in terms of walking distance from the nursing station (41 percent) and visibility of the patients for monitoring purposes (40 percent)
- Surveillance of patients was considered somewhat problematic in both single- (40 percent) and double-occupancy rooms (34 percent).
- The most common reason given for a transfer request was privacy (52 percent), followed by patient behavior issues (36 percent) and infection control (27 percent). Future studies may rely on multi-method data collection, such as observation and log entries, as well as respondent surveys, in order to gain more accurate information on the tasks, time and cost involved in patient transfer.
- Staff efficiency is greater in single-occupancy rooms, according to more than half of the study participants (53 percent), and 58 percent of nurses noted that patients use less medication in single-occupancy rooms.
- Respondents felt that single-occupancy rooms have better access to bathing facilities (93 percent), more space for storage and equipment (86 percent), and are better suited for different ethno-cultural groups and family members (96 percent) compared to double or multi-occupancy rooms.
- Eighty-four (84) percent of the respondents rated room flexibility as high or very high in single-occupancy rooms, whereas only 40 percent of nurses felt double-occupancy rooms are moderately flexible.
- Single-occupancy rooms were chosen as most appropriate for patient examination (85 percent) and collection of a patient's history (82 percent) compared to less than half of the respondents rating double-occupancy rooms as low in their suitability for patient examination and collection of a patient's history.

- Fifty-seven percent of the respondents stated that the rate of acquiring a nosocomial infection is either low or very low in single-occupancy rooms, compared to 11 percent respondents stating that the rate is high or very high in single rooms. As for double rooms, 10 percent respondents felt that the rate of acquiring a nosocomial infection is either low or very low, compared to 46 percent respondents stating that the rate is high or very high in double rooms.
- The incidence of patient falls was considered moderate in both types of rooms (48 percent). Similarly, the rate of taking pain reducing or sleep inducing medicine was considered moderate in both types of room (37 percent in single-occupancy rooms; 33 percent in double-occupancy rooms).

The primary objectives of this pilot study were to gather an experience-based assessment from hospital staff in regard to single versus double patient rooms and to examine the validity and relevance of the two survey questionnaires. The results generally support the positive aspects of single rooms from a patient care perspective, as suggested by the literature. The limitations of this study include limited sample size and limited data on operating costs. Findings need to be interpreted with these limitations in mind. Future studies need to examine carefully the implications for operating costs of the positive assessments of patient care issues associated with single rooms. An in-depth case study approach using multiple methods (e.g., systematic observations, information from data logs, qualitative interviews) can provide more useful data in regard to the complex relationships among patient care issues, operating cost variables, patient outcomes, and staff efficiency, as well as subjective evaluations by patients and family members. See the document *Pilot Study on Comparative Assessment* for full report.

Issues for Future Research:

It is evident from this research project that in order to better understand the advantages and disadvantages of single versus double rooms, future research needs to examine the effects of design of patient rooms and nursing units, staffing, care procedures and practices on operating costs. Although cost of construction is an important factor in the consideration of single versus multi-occupancy rooms, room area and design of patient rooms, nursing unit configurations, etc., it is relatively insignificant over the lifetime of the building. Eventually, the operating costs become the truly relevant factors in terms of seeking out efficient and meaningful strategies in design, staffing and care delivery that can positively impact cost containment and reduction.

In this study, we provided comparative first cost analysis of single and double occupancy patient rooms. However, issues related to operational cost was only covered through some experiential data provided by the frontline staff at the four study hospitals. We believe that future studies could be designed with an in-depth methodology by collecting concrete data with direct staff input over a period of time, and focusing primarily on

specific patient care tasks/activities and their relevance to operating costs. Multi-method of data collection including observation, information from data logs and interviews is required to gain more detailed information. However, in order to have a meaningful understanding of the associated issues, measurement of operating cost with variables such as staff travel time, paperwork, maintenance, infection control, transfer, etc., need to be conducted along with the variables of a therapeutic environment. It is important to recognize the apparently intangible benefits of a patient-focused and positive environment on patient satisfaction, morale and self-efficacy.