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

A Review and Analysis of the Literature

Submitted to
The Coalition for Health Environments Research

by
Habib Chaudhury, Atiya Mahmood and Maria Valente
Simon Fraser University

November 20, 2003
Overview

Aging of the population in the United States has resulted in increased prevalence of chronic and acute conditions that require hospitalization and this will play a central role in driving the future demand of inpatient care (Ulrich, 1992). Demographic changes (e.g., the aging baby boom generation, increasing life expectancy and continued immigration) could result in a 46 percent increase in acute care bed demand by 2027 (Solucient, 2003). One effect of increased acuity in patients is that hospitals are designing inpatient care units much more like critical care units. Nursing stations are being designed to allow for closer proximity of nurses to the patients and to other nurses. According to Burmahl (2000), built-in flexibility in design is becoming more crucial, mainly because technology is quickly obsolete and patient populations are constantly changing. Today’s patient room may be tomorrow’s intensive care unit, so flexibility is essential. However, the trend is also to design therapeutic environments --wellness-oriented, healing environments – that incorporate family-centered care and include organic elements like natural light, plants, water, color and texture in their design schemes. In recent years, health care designers and administrators have become more aware of the need to create patient centered and psychologically supportive acute care environments (Gerteis et al., 1993; Ulrich, 1999). The challenge is to design patient rooms to be more like intensive care rooms, yet achieve a better healing environment. How does the need to address increased acuity, as well as the need to promote therapeutic outcomes affect patient density issues in patient room design?

Single patient rooms have become the industry standard in new construction of acute care facilities in the United States. Healthcare design professionals and planners argue that private patient rooms reduce the possibilities for infection, facilitate nurses and healthcare workers’ ability to do their jobs efficiently, provide adequate spaces for family members to participate in the healing process of the patients, and afford a greater measure of privacy for the delivery of bedside treatments and for sensitive discussions with health-care personnel (e.g., Bobrow & Thomas, 2000; Gallant & Lanning, 2001; Hill-Rom, 2002; Hohenstein, 2001; Solovy, 2002, Ulrich, 2003). Additionally, they claim that this type of room design reduces noise levels and
traffic in and out of patient rooms and contributes to a reduction in patient stress levels, which in turn results in faster healing time for the patient (e.g., Bacon, 1920; Cabrera & Lee, 2000; Tate, 1980). However, are these claims supported by empirical evidence?

An extensive review of literature in the area of healthcare design, construction and operating cost, hospital management, staff efficiency, infection control and patient outcomes was conducted to identify advantages and disadvantages of single versus double occupancy patient rooms. The research questions that guided this review are:

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?

To address the study research questions and facilitate the review and analysis process, the articles and chapters reviewed were divided into four categories. Additionally, the articles in each category were subdivided into empirical and non-empirical articles. Articles that presented primary data and findings from a research project were grouped under the “empirical” sub-category. Articles and chapters that were either reviews of other studies or prescriptive in nature, or that covered general descriptive information were grouped under the “non-empirical” sub-category. The four general categories of the literature review are as follows:

i) First and operating cost of hospitals
The review included articles that discussed issues that affect first and operational costs of acute care settings. Most of the articles in this section were non-empirical in nature and provided a general overview of cost factor in acute care settings. An extensive literature search revealed a limited number of articles that addressed cost factors relative to room occupancy.
ii) **Health care facility management and hospital design**
In this section, literature on current hospital design trends and the reasons behind these trends were reviewed. Additionally, some literature on hospital management was reviewed. The literature searches were also conducted on nursing unit layout, room occupancy rates, patient transfers, efficiency related to medical procedures and staff walking distance. There were more non-empirical articles in this section.

iii) **Disease control and falls prevention**
The review of literature in this category included articles on nosocomial infections in hospitals and their relationship to environmental factors. Articles on falls in hospitals were also reviewed to identify any linkages to the built environment and design.

iv) **Therapeutic impacts: Relationship between healing and environment**
This section mainly dealt with articles and chapters that discussed the contribution of environmental factors to the healing process. It covered issues of room size, acoustics, room location, ambient characteristics, privacy, confidentiality and stress reduction. Many of the articles in this section were empirical in nature and provided useful information on health outcomes as they relate to built environmental factors.

The articles in the “Healthcare facility management and hospital design” and the “Therapeutic impacts: Relationship between healing and environment” categories are interrelated and have overlapping ideas and issues. Though these two categories are separate in the annotations and summary charts (see Appendices A and B), highlights from the findings in these two categories are combined later in this summary section due to their interrelated nature.

**Literature review methods**
Several strategies were used to identify potential studies/articles for the review. First, a keyword search of relevant databases was conducted. The databases searched were: Medline, EBSCO Host, ABI/Inform, Ageline, Clinical Reference Systems, Digital Dissertations, Healthsource: Nursing and Academic, JSTOR, PsycINFO, Science Direct, EMBASE, Pubmed, World Cat,
Social Sciences Citation Index, Simon Fraser University and affiliated libraries’ catalogues. Second, potential studies were identified by a systematic review of issues of relevant journals/magazines in the area of healthcare design, management and infection control.¹ The literature search demonstrated 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 issues and dating earlier than 1980 were also included in the review. Finally, the reference lists for included articles that dealt directly with room occupancy issues were inspected. In each case, articles and chapters that were potentially relevant were collected and assessed for appropriateness.

**Keyword searches included:** hospital design, healthcare facility design, acute care, hospital planning, hospital management, single occupancy rooms, private rooms, semi-private rooms, multiple occupancy rooms, double occupancy rooms, patient rooms, ward design, isolation and infection control, cost analysis in hospitals, first cost, energy cost, operating cost of hospitals, falls incidence and prevention, patient occupancy rates, patient transfer, design and well-being, patient-centered care, cooperative care, health and environment, social interaction, privacy, nursing efficiency in hospitals, etc.

The findings from the literature review are presented in a chart format to provide information in a concise manner (see Appendix A). In addition, an annotated bibliography provides a summary of key issues from each article or chapter (see Appendix B).

¹ Journals/magazines/newsletters searched for relevant articles:
- **Social, Psychological and Behavioral issues**- Social Science and Medicine, Journal of Environmental Psychology, Environment and Behavior, Behavior Research and Therapy, Health Psychology, Journal of Personality and Social Psychology.
The formats of the charts for empirical and non-empirical articles are as follows:

Chart format for empirical studies:

<table>
<thead>
<tr>
<th>Study</th>
<th>Focus of study</th>
<th>Research Design</th>
<th>Sample information and site</th>
<th>Findings</th>
<th>Relationship of findings to room occupancy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Chart format for non-empirical articles and chapters:

<table>
<thead>
<tr>
<th>Article</th>
<th>Focus of article</th>
<th>Type of healthcare facility</th>
<th>Recommendations for healthcare settings</th>
<th>Relationship of recommendation to room occupancy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The following graph (Figure 1) provides the number of empirical and non-empirical articles reviewed under each category of the literature review. It illustrates to the reader the type and quantity of the articles reviewed.

![Graph](image)

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

The next section provides an historical overview of hospital development and patient room design. This is followed by highlights from the review and analysis of literature.
Historical Overview and Context

The healthful environment it provides for patients, the amount of privacy it allows patients, the extent to which it exercises supervision and control over patients, and the efficiency with which it can be operated. These we call the four elements of ward design.

*Thompson & Golden, 1975, p. xxviii*

Today [in the United States] the patient room is seen as a place of sanctuary, privacy and safety—the place where the patient and the family are in control of their lives and environment. The patient room can now house the family, if necessary, and can be designed as an extension of the daily life of the patient, with total access to the world.

*-- Bobrow & Thomas 2000, p. 132*

As background for the review of literature, this section provides a brief overview of the development of the hospital as it relates to patient room issues. The hospital, as it is known today, has undergone various changes throughout past centuries. Verderber & Fine (2000) identified six periods in history through which hospital design has evolved. These include the Ancient era, the Medieval period, the Renaissance, the Nightingale era, the Minimalist Megahospital and the Virtual Healthscape. Among the first four periods, the Nightingale era is most relevant in terms of room layout and occupancy.

Based on her nursing work during the Crimean War, Florence Nightingale wrote two seminal books, *Notes on nursing* (1858) and *Notes on hospitals* (1859), in which she spelled out her theories on nursing practice, hospital planning and design.\(^2\) She was a strong proponent for large multi-occupancy wards (over 30 patients), favoring them over private rooms and small-scale wards because she wanted to improve the work environment for the nursing staff (Jones, 1995). Nightingale argued from the point of view of staff efficiency, and highlighted the ease of supervision and better quality of care, as well as the spaciousness in large multi-occupancy wards compared to private rooms. She indicated that benefits of staff efficiency and increased health status (as in multi-occupancy wards) outweighed the need for individual privacy (as in single-occupancy rooms) (Seymer, 1954). Nightingale’s reforms, as well as advancement in medicine, resulted in hospitals that were places of healing rather than places of dying. This in

\(^2\) Her guidelines for hospital reform addressed the maximum allowable width and length of a ward, the size of windows and their placement in relation to the bed, the overall ambience, the heating and ventilation systems, and the use of specific materials and colors. St Thomas Hospital in London, which opened in 1871, was the first hospital that used her guidelines in the planning of its wards (Verderber & Fine, 2000).
turn resulted in hospitals being used not only by the poor, but also by the wealthy. People from the upper income groups wanted privacy during their healing process, so they created a demand for single-occupancy rooms. Gradually, private and semi-rooms replaced multi-bed large wards in hospitals and, by the mid-twentieth century, the Nightingale ward was a dying template (Miller & Swensson, 1995). However, in the 1950s and 1960s, many hospitals still favored open smaller wards over private rooms because of the staff efficiency issue. Even in the early 1970s, advocates of multi-occupancy rooms were stating that patient privacy (in single occupancy rooms) meant a sacrifice of continuous supervision. They attributed the trend towards single rooms in hospitals to the general movement towards privacy in all aspects of 20th century life (Thompson & Golden, 1975). The all-private-room argument was waged mainly as a reflection of societal progress rather than on the basis of strictly rationalized medical justification (Verderber & Fine, 2000).³

According to Verderber and Fine (2000), the United States was one of the first countries to reject the multi-bed ward concept. This shift began after the Second World War and was nearly complete by the early 1970s (with the exception of some urban charity hospitals and large state-run institutions). Although the trend was to develop all private rooms in hospitals, such inpatient facilities often compounded the patient’s sense of alienation, dislocation and fear that is part and parcel of the hospitalization process (Verderber & Fine, 2000). By the 1970s some hospital designers began to lobby for hospitals that offer several variants of the medical-surgical units, consisting of a mixture of private rooms, double occupancy rooms, and small wards of up to six beds (Verderber & Fine, 2000). In the past two decades, hospitals in the United States have tended to build more private patient rooms and most renovations done or planned for the future have also favored maximizing single-bed rooms.

Though private patient rooms gained popularity in the latter half of the twentieth century, advocates like A. Bacon, Superintendent of Chicago’s Presbyterian Hospital, were recommending them from the early part of the 20th century. Bacon (1920) argued that this type

³ Countries that have some form of universal healthcare coverage (e.g., Britain, Canada), patients pay more for private rooms, thus a majority of the hospitals have more small scale wards (four to six patients) and double occupancy rooms than single patient rooms. These types of multi-occupancy patient rooms continue to find medical, religious, economic and social justification in many developed and developing countries.
of room design not only provided patients more privacy and comfort, but also addressed the hospital’s goal of maximum occupancy. Recent publications (e.g., Bobrow & Thomas, 2000) have provided support for his claim by stating that almost 100 percent occupancy can be achieved in single occupancy rooms versus 80 percent occupancy in double or multi-occupancy rooms. Bacon (1920) also mentioned that hospital-acquired infections were reduced in single rooms and that medical personnel were better able to examine patients and to collect more complete medical histories due to the privacy afforded in this type of rooms. Recent studies on infection control (e.g., Kappstein & Daschner, 1991; Muto et al. 2003; Shirani, et al. 1986) support his claim on mitigation of contagion. Ulrich (2003), in his presentation on evidence-based design, stated that a significant number of studies demonstrate that nosocomial infection rates are reduced in single versus multiple occupancy patient rooms, even when controlling for hand washing practices and air quality (the two other key factors affecting control of nosocomial infection).

Preliminary results from ongoing studies (Rich, 2002) support the examination and patient history part of Bacon’s (1920) claim. Additionally, in their study of maternity rooms, Janssen, et al. (2001) discovered that nurses were better able to respond to the needs of patients in single-occupancy maternity rooms, equipment was easily accessed, and privacy was increased.

Nguyen, et al. (2002) mention that in their study on patients’ satisfaction with their hospital stay and care, patients in private rooms were more satisfied with the hospital environment, the staff, and the overall quality of care. Present studies verify that there is merit to Bacon’s early 20th century claims about the benefits of private rooms.

In “Building type Basics: Healthcare facilities,” Bobrow & Thomas have highlighted different advantages of private patient rooms. According to them,

[In single patient rooms] the patient can rest undisturbed by a roommate’s activities. A patient can become ambulatory earlier when the toilet and shower are in the room, and such rooms can be used for many types of isolation. Because patients in single-bed rooms are rarely moved, medication errors are greatly reduced [There is a reduction of patient transfer cost for the institution]…. In units with multi-bed rooms the number of daily moves has averaged six to nine per day, at a significant cost in added paperwork, housekeeping, patient transport, medication instructions, etc.

-- Bobrow & Thomas, 2000, p. 145
The efficiency and effectiveness of patient room design is tied to a large extent to the nursing unit design. As patient rooms gradually shifted from multi-occupancy to single occupancy units in the United States, the design of the nursing units also evolved. Staff work efficiency, walking distance to rooms and monitoring capacity are all related to nursing unit design and this is true for both multi- and single occupancy patient rooms. Designers and administrators should evaluate the benefits and shortcomings of single versus multi-occupancy patient rooms within the context of the different types of nursing unit layout and design.

The Hill-Burton Program that started in 1947 and remained in operation into the early 1970s gave rise to many of the hospitals built in the suburbs to support the housing constructed during that time (Jones, 1995). Thus, many of the current hospitals in the United States are approximately 40 to 50 years old. Because of the changing demographics, increase in ambulatory care, advancement of technology and increase in patient acuity during admission, medical care is very different than it was in the 1950s and 1960s. Hospital and patient room design and renovation in the 21st century need to address these changing needs and demographics. Thus, the type of density in patient rooms needs to be guided by design principles that are patient focused, have therapeutic impacts, reduce inefficiencies and increase staff productivity.

This section provided some background information about the evolution of multi- and single patient rooms in hospitals in the United States. The following sections provide a summary of the findings from literature on the four themes mentioned earlier.

---

4 The Planetree movement, originated by Theriot in 1978, has tried to address some of these issues and has impacted hospital design by creating an emphasis on patient-centered care. After her negative experience in a hospital, Theriot “founded a nonprofit organization to provide health and medical information aimed at improving the quality of patient care” (Miller & Swensson, 1995, p. 177). The Planetree guidelines place an emphasis on creating a comfortable, soothing, and homelike environment for the patient (Martin et al., 1998). New models of patient care rooms--mainly private rooms--such as acuity-adaptable rooms and universal or family-oriented rooms are being designed to address some of the current patient and staff needs. Description of these types of patient rooms is provided in a following section.
Highlights from the Literature Review

While a number of issues and patterns were discovered about the cost, patient care, management, disease control and therapeutic impact of environmental factors, highlighted below are some of the more pertinent and prominent findings related to cost issues.

First and Operating Costs of Hospitals

Even though staff costs account for around 70 percent of the running costs of hospitals, hospitals are still being built and modernized, not with smooth care processes or savings in operational costs in mind, but in accordance with age-old space and operational models seeking to minimize building costs.

-- Paatela, 2000, p. 2

Healthcare construction cost expenditures have gradually increased over the years. In the United States, this amount has risen from 11.6 billion in 1997 to 18 billion in 2001, and it is expected to rise to 27 billion by 2010 (Coile, 2001; Crosswall, 2001 & 1999). According to Coile (2001), the rise in healthcare facility construction will be driven by the aging of the Baby Boom generation and the expansion of the population to 300 million by this decade. Hospital cost covers a significant portion of the national healthcare expenditure in the United States. Though there are not many articles exploring the relationship between first costs and operating costs, the consensus among the few that compare these two cost factors is that operating costs are proportionately more than the capital cost of hospitals and this is true even for cost estimates within the first five years of construction.

The review of literature on hospital costs revealed that there are very few articles that address the relationship between hospital’s first or operating costs and room occupancy. Most articles on hospital expenditure (e.g., Bachelor & Esmond, 1989; Smet, 2003; Yafchak, 2000) dealt with overall capital or operating cost and methods of cost reduction in hospitals. Some articles (e.g., Berry, 1974; Li & Rosenman, 2001; Hoppszallern, 2003; Woodlander & Himmelstein, 1997) provided comparative cost information in different types of hospitals; others discussed methods of evaluating hospital costs accurately (e.g., Baker, 1998; Doyle et al., 1996; Udpa, 1996, etc.). However, hardly any research addresses how patient room density affects hospital expenditure in

5 In 1998, hospital care expenditure was 383.2 billion dollars (33.4 percent of the total health care expenditure) and it is expected to be 649.4 billion dollars in 2007 (30.4 percent of the total healthcare expenditure) (Inglehart, 1999).
terms of first costs. The following discussion focuses on hospital design and operational cost. Even within this category the literature is limited.

**Operational costs in hospitals**

There are several non-empirical articles/book chapters that mentioned that, in general, operating costs account for over 70 percent of the hospital’s overall cost and are usually the same as capital cost within the first three years of construction (Bobrow & Thomas, 2000; Paatela, 2000). Berry (1974), in studying factors that affect hospital costs, determined that wage rate was the most significant factor in explaining average costs; construction costs of the facility did not contribute to the explanation.

Drake (2001), in his article on hospital management and cost, stated that capital improvements (first cost) on a healthcare campus typically account for no more than 10 percent of the total cost of providing care, but efficient designs can lower overall operating costs and enable healthcare providers to administer innovative care in the most convenient, professional and cost-effective environment possible. He further mentioned that patient-focused care has brought about as much as a 10 percent reduction in staff cost without compromising care quality or patient satisfaction.

Paatela (2000) argued that the operational costs of a new hospital or modernized section are as high as the capital (investment) costs within 3 years, and that there is a tendency in the Western world to build hospitals to increase “productivity” and the number of patients treated per staff unit. This requires space arrangements that enable the smooth running of care processes, the delivery of patient-centered care, and the appropriate placement of procedures and treatment, while minimizing the movement of patients and all the unnecessary waiting, reporting and errors this movement entails.

Some authors stated that operating costs are reduced in single patient rooms compared with multi-occupancy rooms due to reduction in transfer and labor cost and higher bed occupancy rates. Bobrow & Thomas (2000) mentioned that operational costs of hospitals are reduced in single occupancy patient rooms compared to multi-occupancy rooms. They argued that, even with higher first or unit costs of construction, furniture, maintenance, housekeeping, energy costs (e.g., heating and ventilation) and nursing costs, single occupancy can match the per diem cost of
multibed rooms because of the higher occupancy rates.\(^6\) This enables the hospital to take care of the same size population with fewer beds.

In an earlier book on hospital design, Thomas and Goldin (1975) argued that, economically, multiple-occupancy rooms are the most efficient. In these types of rooms, patients can be placed along one corridor, facilitating the supervision of patients and reducing the amount of time nurses spend traveling. Thomas and Goldin proposed a six-bed room, with three beds on each side of the room, as the most economical configuration. Costs associated with nurses’ travel time are reduced in multi-occupancy rooms compared to single occupancy rooms. Traffic costs/nurses’ travel time costs are higher in private rooms, and this increases proportionately as the number of patients in rooms decreases (Delon & Smalley, 1970). However, staff travel time is only one variable under consideration when designing patient room layout and density. Often the advantages of single-occupancy rooms--for example, improvements in patient care, a reduction in the risk of cross infection, and greater flexibility in operation--may outweigh the greater travel distances (and the related cost values) associated with private rooms.

Berry, Colle, et al. (as cited in Ulrich, 2003) argued that hospitals can reduce costs through reducing density in patient rooms. Their estimates for a hypothetical hospital, Fable Hospital, demonstrated over $3 million savings in patient transfers cost, over $80,000 dollars savings through a reduction in nosocomial infections, and over $3 million savings through a reduction in patient falls and drug costs through upgrading of multi-occupancy rooms to large single occupancy rooms and acuity-adaptable rooms.

**Overhead and Administrative Costs**

Overhead costs affect overall hospital costs. The volume of patients, bed availability, and the complexity and costs of services influence overhead costs (Smet, 2002). Due to a trend towards greater outpatient care and lower occupancy levels, hospitals are experiencing greater overhead costs (Yafchak, 2000). Woodlander, Himmelstein & Lewontin (1993), in their evaluation of

---

\(^6\) Occupancy of multi-bed rooms can reach up to a maximum of 80-85 percent, whereas single rooms have the potential to reach 100 percent occupancy.
administrative costs in U.S. hospitals, discovered that administration cost accounted for an average of 24.8 percent of each hospital’s expenditure in 1990.

Transfer costs

In terms of transfer cost, Bobrow and Thomas (2000) indicated that hospitals save money by reducing patient moves in single occupancy rooms. “In units with multibed rooms the number of daily moves has averaged six to nine per day, at a significant higher cost in added paper work, housekeeping, patient transport medication instructions, etc.” (Bobrow & Thomas, p. 145).

In Bronson Methodist Hospital’s new 348 private room facility, there was a reduction in transfer costs compared to their older multi-bed facility, as demonstrated by initial findings during ongoing research at the hospital. In the old facility, the hospital spent around $500,000 per year in patient transfers due to problems with roommates or infection-control issues; these problems have been greatly reduced according to the hospital’s chief executive (Rich, 2002). Bronson Methodist Hospital, upon adopting all single-occupancy rooms, saved $500,000 per year in transfer costs, while Clarian Methodist Hospital saved $5 million per year by building acuity-adaptable rooms (Ulrich, 2003). Patient transfers at the latter facility have decreased by ninety percent and medication errors have also declined (Hendrich, Fay, & Sorrells, 2002). Gallant & Lanning (2001), in their article on acuity adaptable rooms, demonstrated that the less a patient is moved, the greater the reduction in cost. The research they quoted in their article demonstrated that the transfer time from a critical care room to a patient room is approximately seven labor hours. Thus, by keeping a patient in a private acuity adaptable room, the hospital cuts down on the salary cost associated with seven labor hours required for patient transfer.

Berry, Colle, et al. (as cited in Ulrich, 2003) generated some estimates of cost reduction in hospitals through upgrades of multi-occupancy rooms to private rooms, including oversized single-occupancy rooms and variable acuity rooms. They calculated cost reduction estimates for a hypothetical hospital, Fable Hospital, and demonstrated that this hospital could save over three million dollars in patient transfers alone, by upgrading to single occupancy rooms from multi-occupancy rooms.
**Length of Stay**

A patient’s length of stay is associated with hospital costs. The first days of hospitalization are generally the most expensive, regardless of the type of illness (Berry, 1974) and, by decreasing the patients’ length of stay, hospitals can become cost-efficient (Smet, 2002). Gallant & Lanning (2001) stated that patients remaining in one private acuity adaptable room throughout their stay tended to recover faster. Their article illustrated that patient stay was reduced from 9.5 days to 5.4 days in five diagnostic related groups (DRGs) in private acuity adaptable rooms in Linda Loma hospital in California.

According to Jones (1995), patients change their room assignments on average four times during a typical admission. Approximately 40 percent of nursing hours are used to manage patient logistics, time taken away from patient care issues. Studies (e.g., Hill-Rom, 2000) demonstrate that there are more patient transfers from multi-occupancy rooms than from private rooms. Thus, from the perspective of patient transfer issues, private rooms seem to be the more suitable choice than multi-occupancy rooms (more discussion on this issue follows).

**Healing Design and Cost**

According to some advocates of healing design, hospital designs that address therapeutic goals also help to reduce hospital expenses. Aspects of healing design that lead to cost reduction are as follows:

- Shorter length of stay;
- Lower cost per case;
- Reduced use of stronger drugs;
- Reduced nurse hours per patient;
- Reduced turnover (due to improved staff morale) and reduced costs for recruitment (Coile, 2001b, p.12).

Recent ongoing studies on hospital rooms are demonstrating that using private rooms as part of the healing design process has the potential of reducing length of patient stay in hospitals and thus of reducing pain medication intake in private rooms. Private room design that supports the presence of family members reduces patients’ falls incidence (Ulrich, 2003) and may reduce the
requirement of nurse hours per patient, because family members are participating in the caregiving process.

Parker (1991) estimated the cost savings in a 300-bed (private rooms) hospital environment that was designed to address patient needs. As a result of shorter patient stays, drug intake reduction and reduction of labor cost, the cost savings in that hospital was 10 million dollars per year in the early 1990s. Parker argued that the savings in staffing cost alone would justify building a healing hospital. His estimates for 1991 demonstrated that the cost of recruiting a nurse was $20,000 in the United States. Thus, by reducing the nursing labor requirement the hospital could accrue significant savings. In recent years, the average nurse recruiting cost is between 72,000 and 87,000 dollars a year or $42-$50 per hour (O’Neill, 2001 as cited in Coile, 2001b). Based on current expenses and labor cost, Parker’s 10 million dollar estimate could mean 15-20 million dollars in savings at present.

The articles/chapters that directly or indirectly related cost to room occupancy demonstrated that multi-occupancy rooms may be cost effective in terms of patient monitoring and staff walking distance. However, private rooms, when they are a part of a healing design process, often reduce operational costs in hospitals through shorter patient stays, a lower nursing labor requirement and drug intake reduction. Additionally, cost may be reduced in private rooms due to a lower falls incidence and better infection control. These latter two aspects are discussed in more detail in the following section.

B. Infection Control and Falls

Infection Control

Since March 28 [2003], SARS [Severe Acute Respiratory Syndrome] has been the focus of my professional life…The epicenter of the [second] outbreak [in the Greater Toronto Area] is my hospital… My hospital will be extensively studied by Health Canada and the CDC[The Centers for Disease Control] to answer why this happened. There is no doubt that the answer will relate to environmental issues. Part of the answer is going to be simple. The standard for healthcare is going to be private rooms for every patient. Many of our rooms have 2 to 4 patients. Tell me if you would check into a hotel where you shared a bedroom with strangers and shared a toilet with strangers and had to walk down the hall for a shower. Why do we accept this standard in hospitals? We have had VRE [vancomycin-resistant Enterococcus], MRSA [methicillin-resistant S. aureus], and now SARS. I
may be a surgeon, but some things are obvious. I encourage all surgeons to ask their
administrators about plans to create this new type of standard.

--- Feinberg, 2003

The reality is that risk of potential exposure is greater in a double room or open ward than
in a private room. This is not necessarily from VRE & MRSA, which can spread by
surface contact of things, if the room is not thoroughly cleaned but certainly for anything
respiratory (ex. cold, flu, SARS, pertusis/whooping cough)…. Cleaning and scrubbing are
critical for controlling infection but it is the same for both single- and double-occupancy
rooms.

--- Shelton, 2003

Antibiotic-resistant pathogens are an important and growing threat in the hospital environment.
More than 70 percent of the bacteria that cause hospital-acquired infections are resistant to at
least one of the drugs most commonly used to treat these infections (Muto et al., 2003).

Among the various methods recommended for infection control in hospitals, two important
environmental factors are isolation and ventilation. Infected patients or patients highly
susceptible to infections need to be isolated in private rooms with proper ventilation systems in
order to stop infection from spreading and to reduce the possibility of the development of new
infections. Rates of nosocomial infection are affected by handwashing practices, air quality, and
single- versus multiple-occupancy rooms. In particular, single-occupancy rooms appear to have
lower rates of infection than double-occupancy rooms (Ulrich, 2003). Larger-sized, single-
occupancy rooms are recommended for infection control as they can accommodate equipment,
sinks, and storage (Ognibene, 2000). Preliminary findings at Bronson Methodist Hospital in
Michigan demonstrate that private rooms, location of sinks and air-flow design have resulted in a
10 to 11 percent decline in overall nosocomial infections rates (The Center for Health Design,
2003). These findings at Bronson Methodist Hospital indicates that private rooms in conjunction

--- Dr Stan Feinberg, shared this information through an internet listserv. He is currently the Chief of Surgery at the
North York General Hospital, Toronto, Ontario.

--- Nosocomial infections occur in more than two million hospitalizations each year (Haley, R. W. et al., 1985). The
Joint Commission on Accreditation of Healthcare Organizations (JCAHO) cited federal statistics that 2 million
people in the United States acquire an infection each year while being treated in a hospital for other reasons and
90,000 die as a result. Due to this high incidence of hospital related infection, JAHCO is issuing new standards that
go into effect in January 2005. Under the new standards, hospitals will be required to make an infection-control
program a major component of safety and performance improvement programs and to perform ongoing assessments
to identify risks for transmission and acquisition of infectious agents. (Morrissey, 2003)
with other design modifications can reduce infection rates in hospitals. However, additional research in multiple hospitals, using similar precautions is required to understand fully the relationship between room layout, air-flow design, fixture placement, patient density and infection control.

Additionally, studies have demonstrated that prolonged hospitalization and intra-hospital patient transfer may increase the probability of infection (Tornieporth, et al., 1996, Wakefield et al., 1987). It was mentioned earlier that private rooms help to reduce patients’ hospital stays, thereby reducing their probability of acquiring nosocomial infections, as well as cost associated with such hospitalization.

Isolation

Isolation of patients is one of the recommended precautions to prevent the occurrence of infection and isolation can only be possible through confinement of the patient in a private room, often with specialized ventilation systems. Kappstein & Daschner (1991) suggested that private rooms are needed for patients suffering from staphylococcal pneumonia, skin lesions, or methicillin-resistant S. aureus (MRSA), as these patients carry organisms that can lead to environmental contamination, and MRSA has the potential to become widespread. Since proximity to an un-isolated patient with vancomycin-resistant Enterococcus (VRE) can lead to the spread of this infection, patients suffering from VRE also need to be kept in isolation, according to the Society of Healthcare and Epidemiology of America (SHEA) guidelines (Muto et al., 2003). However, some experts in the area of hospital epidemiology have critiqued the SHEA guidelines for being based on evidence that is still inconclusive (Eickhoff, 2003). Thus, caution should be used when interpreting the SHEA guidelines.

Research by Byers et al. (2001) demonstrated that the most important risk factor for acquiring VRE during an outbreak was proximity to unisolated patients who became culture positive during the preceding seven days. Montecalvo et al. (2001) illustrated that the implementation of an active surveillance and isolation program for VRE terminated an outbreak at Westchester County Medical Center. Additionally, this program was cost-effective, with reported annual cost
savings of $189,318. However, these results were based on findings from single outbreaks and may not be applicable to all healthcare delivery sites.

In a study on the transmission of the Hepatitis C virus (HCV) in a hematology ward, Silini et al. (2002) discovered that there was patient-to-patient nosocomial HCV transmission. After having analyzed possible routes of transmission, the researchers recommended several preventive measures that included isolation of patients during neutropenic phases. Allander et al. (1995) also discovered that HCV was frequently transferred from one patient to another in a Hematology ward, and their findings highlighted the need for isolation of patients to reduce the spread of HCV. In another study (Korpela et al., 1995) on hospital-acquired diarrhea, it was discovered that nosocomial transfer of Shigell spp. occurred between patients sharing rooms and toilets. The researchers highlighted the importance of the isolation of patients with diarrhea in a hospital setting.

Most studies discussing the relationship between infection control and the built environment recommended isolation to reduce the spread of infection. However, a recent study (Stelfox, Bates, & Redelmeier, 2003) explored care issues of patients in isolation. The researchers of this study discovered that when patients were in isolation due to infection control, the quality of care they received differed from that of patients who were not in isolation. Stelfox, Bates, & Redelmeier (2003) noted that isolated patients were twice as likely as control patients (patients not isolated) to experience an adverse event during their hospital stay. Supportive care failures, such as falls and peptic ulcers, were more likely among isolated patients, as were incomplete recordings of their vital signs. Hospital stays were also longer for isolated patients and their dissatisfaction with their treatment was greater than that of control patients. The findings from this study were contrary to the findings of other studies that demonstrated that private rooms are beneficial to the patient’s recovery process. Additional studies are needed to examine the relationship between infection control, private rooms and patient satisfaction to determine the quality of patient care for isolated patients, as well as the need for isolation for different types of disease.
Ventilation

Ventilation is also critical in the control of airborne pathogens for both protective (burns) and infectious (respiratory) isolation (Marier, 1996). For protective isolation and special procedures, the movement of air relative to adjacent areas must be positive and for infectious isolation, it must be negative (AIA/CAH, 1992, pp.52-54). In particular, patients suspected of having an airborne infectious disease should be placed in negative pressure rooms that receive numerous air changes per hour (Sehulster & Chinn, 2003). During an outbreak of airborne infection, whole units of single rooms may need to be converted to negative pressure rooms in order to minimize transfer to other parts of the hospital.

Centralized, filtered, unrecirculating air handling systems with an efficient preventive maintenance program should keep airborne organisms at a minimum in hospital rooms used for isolating patients (du Moulin, 1989). Du Moulin (1989) argued that the single patient cubicle should be mandatory in the design of intensive care units. Physical separation not only contributes to a decrease in the spread of endogenous flora, but also serves as a constant reminder and barrier to cross-contamination by unit personnel. In their study on the effects of negative pressure ventilation on the spread of nosocomial infection, Anderson et al. (1985) discovered that, in wards with this ventilation system, secondary spread of Varicella zoster did not occur. The rooms on these wards were single-occupancy, as patients were in isolation.

Various isolation strategies are used to prevent infection during bone marrow transplantation. A study by Passweg et al. (1998) examined whether patients treated in high efficiency particulate air filtration (HEPA) and/or laminar airflow (LAF) private rooms had decreased transplant-related mortality (TRM) in the first year after allogeneic transplantation compared to conventional isolation units. Their findings demonstrated that the use of HEPA and/or LAF to prevent infections decreased TRM and increased survival after bone marrow transplants for leukemia. This finding illustrated that the isolation of patients in private rooms, in conjunction with effective environmental controls (like the use of a proper filtration system or a ventilation system) helps in infection control and reduces patient mortality.
Hospital Stay and Intrahospital Transfer
A study conducted by Tornieporth et al. (1996) demonstrated that prolonged hospitalization is a risk factor for Vancomycin-resistant Enterococcus faecium (VREF). Additionally, the researchers discovered that intrahospital spread of VREF may have been facilitated by patients who were transferred to more than one ICU or more than one floor during their hospitalization. These patients had a two to threefold higher risk of acquiring VREF. We know from other studies that hospital stay is reduced if patients stay in single occupancy rooms, and there is less need for transfer in these types of rooms.

Wakefield et al. (1988) assessed the extra costs due to serious *S. Aureus* nosocomial infection and discovered that 77 percent of the cost was related to per diem costs for extra days spent in hospitals, 21 percent was due to anti-microbials for treating the infections and 2 percent was due to laboratory costs. In a recent research, Zhan & Miller (2003) discovered that infection due to medical care was associated with the increase of 9.58 days in hospital stay, 38,656 dollars in excess charges and 4.31 percent attributable mortality. Another study (Pittet, Tarara, & Wenzel, 1994) on the relationship between nosocomial infection in surgical patients, length of stay, costs and mortality rates demonstrated that the surgical intensive care unit stay doubled for patients with infection (their median hospital days was also 24 days longer than patients without infection) and extra cost attributable to infection averaged 40,000 dollars per patient. It is well known that nosocomial infection is a serious patient safety issue and it is also an economic cost burden (Press Ganey Associates, 2003; Stone, Larson & Kawar, 2002). Recent ongoing studies have demonstrated that nosocomial infection rates go down in single patients rooms with proper design and ventilation systems (The Center for Health Design, 2003). Thus, hospitals may save in operational costs associated with nosocomial infection if patients are isolated in private rooms that have proper ventilation and other infection control protocols in place. Additional research is required to understand the relationship between private rooms, patient length of stay, costs and hospital-acquired infection.

Burn Victims and Immuno-suppressed Patients
Burn victims require added precautions in infection control due to their heightened susceptibility to infections. Shirani et al. (1986) studied burn victims in terms of the spread of infection and
mortality. Burn patients in nursing units with a majority of single rooms, with each room containing a sink for hand washing, were less likely to acquire an infection than those in an open ward. Because of this factor, mortality was significantly lower on the closed ward.

Researchers have stated that Immuno-comprised patients may need to be placed in private rooms where positive pressure is maintained. Furthermore, time spent outside their rooms should be minimized, and these patients should be provided with respiratory protection (Sehulster & Chinn, 2003). Due to their suppressed immune systems, HIV patients are more susceptible to infections than are non-HIV patients with similar patient characteristics. These types of patients when hospitalized may require isolation in rooms with proper ventilation, in order to reduce the probability of contracting hospital-related infections (Muto, 2003).

Multiple studies have demonstrated that private rooms with proper ventilation (when required) often optimize the use of appropriate precautions and may facilitate infection control in hospitals. Private rooms do provide more flexibility in changing from positive to negative pressure ventilation and may be more useful than multi-occupancy rooms for airborne disease outbreaks. However, one factor that should be kept in mind when reviewing infection control literature is that findings and recommendations often apply to specific institutions (as the studies are often retrospective investigations of infection outbreaks in particular settings) and may or may not be applicable to other settings; thus, caution must be used in interpreting these results.

Patient Falls

Patient Characteristics

Patient characteristics are critical in determining the occurrence of falls. Older patients and males are more likely to experience an adverse event, as are patients with longer lengths of stay. These adverse events are associated with higher hospital costs (Jones, Simpson, & Pieroni, 1991;

---

9 One has to keep in mind that private rooms by themselves may not be very effective in infection control without proper precautions such as handwashing and use of protective gear. For example, during the recent SARS outbreak in Toronto, transmission problems continued after isolation of patients. The key to curbing the SARS transmission was staff awareness and behavior change. When it is not possible to provide private rooms for all patients, the use of barrier precautions in semi-private room can help reduce transmission.

10 As we have noted elsewhere that single occupancy rooms often reduce a patient’s length of stay in the hospital, room occupancy can be shown to have some relevance to patient falls.
Sutton, Standen, & Wallace, 1994). A recent study (Solomon, 2003; Flaherty et al., 2003) on delirious elderly patients (who are highly susceptible to falling) demonstrated that these types of patients were better cared for in a multi-occupancy delirium room rather than in a private room. For patients who require constant supervision (as in the case of frail and/or delirious patients), and who are more likely to fall in hospitals, multi-occupancy patient rooms with increased surveillance may be more appropriate than private rooms.

Patient Rooms
Consistent within the literature is the implication that most patient accidents occur in patient rooms. Hendrich, et al. (1995), for instance, conducted a study at a Midwest teaching institution. They discovered that most falls occurred in patient rooms, in particular when patients were alone and attempting to get to the bathroom. Similarly, in a geriatric facility where the majority of rooms were multiple-occupancy, most falls occurred when patients were in their rooms, alone or with other patients. Seventy-four of the 444 falls occurring in patient rooms took place when patients were alone in the bathroom (Pullen, Heikaus, & Fusgen, 1999). Langer (1996) also noted that most accidents on a surgical and urological unit in Durban happened while patients were on their way to the bathroom. The majority of falls occurred during the day, while patients were in their rooms, and during visits to the bathrooms.

Since the majority of falls occurred when the patients were alone in their rooms, one may argue that shared occupancy is beneficial, as patients can assist each other and call for help when necessary. Interventions, such as greater monitoring by staff members, can also reduce the number of falls that occur (Hendrich et al., 1995). Recent studies (as cited in Ulrich, 2003) demonstrated that patient falls may be reduced in private rooms that have provisions for family members. The presence of a relative to assist the patient to move around the space may result in a reduction in falls. This finding highlights the need to examine patient room design and layout in a holistic manner and to take into consideration different healing design principles, as well as room density issues. The following sections deal with these aspects of hospital design as they relate to patient room occupancy.
C. Healthcare Facility Management and Hospital Design/Therapeutic Impacts

This section of the summary combines information from articles reviewed in both the “Hospital Design and Management” section and the “Therapeutic Impacts of Design” section (see Appendices A & B for summary charts and annotations). The “Hospital Design and Management” section provides insight into innovations in facility design and suggests improvements and additions that are critical to patient care and comfort. The articles reviewed here are usually prescriptive in nature and often do not provide evidence of patient outcomes. Articles included in the “Therapeutic Impacts of Design” section primarily address the effect of supportive design innovations on patients’ health outcomes. These articles are more empirically based and evaluate the impact of the physical environmental factors. As these two sections are interrelated and have overlapping ideas and issues, we decided to combine the information from the annotations of the two categories in this summary. This summary covers nursing unit and patient room design, patient-centered care as it relates to design (including use of the Planetree model in hospitals), and patient room density as it relates to health outcomes, as well as some general physical environmental elements that have a therapeutic impact on patients.

Patient-centered care and design

Hospital design impacts patient care and, recently, has taken a patient-centered approach (Horsburgh, 1995). This approach creates a homelike environment that is functionally efficient (Martin, 2000). The goal of a patient-centered care hospital is decentralization, which brings services nearer to the patient. Rooms should be humane and provide the patient with privacy, dignity, security, and cleanliness (Miller & Swensson, 1995). This type of care structure strongly promotes single-occupancy rooms in acute care settings.

Planetree model

The Planetree model is patient-centered. It focuses on the spiritual, mental, and emotional needs of patients. Emphasis is placed on patient participation and education (Martin, et al., 1998). Patients are urged to read their own medical charts and to learn more about their illness and treatment through the use of a medical reference library (Weber, 1995). Rooms in Planetree facilities are generally private and large enough to accommodate the patient’s caregiver
Patients are in control of their settings, including lighting, temperature, and
the television. The environment is also made more homelike through the use of soothing colors
and artwork, as well as the ability of patients to bring their personal possessions to the hospital
(Voelker, 1994). Nursing stations are decentralized into pods serving three to four patients
(Leibrock, 2000).

Various facilities in England, and Griffin Hospital in Connecticut, utilized the Planetree model
with double-occupancy rooms. An “L”-shaped room design was intended to give patients a
sense of their own space (McTaggart, 1996; Weisman, 1994). At Griffin Hospital, satellite-
nursing stations and service clusters of three to four patient rooms were used (Weisman, 1994).

Martin et al. (1998) conducted a study comparing patients on a Planetree ward to those on
regular medical units. Planetree patients were significantly more satisfied with their hospital stay
and with the unit’s environment. Planetree patients also had a greater opportunity to interact
with other patients, family members, and friends, and they were more satisfied with the
involvement of nurses and with the education they received.

From a nursing standpoint, it’s better when patients are closer together. With single rooms,
patients are spread out and nurses don’t have a line of vision with patients. Nurses don’t want to
restrain patients and if patients are wandering at night, it is nice to have them grouped closer
together when the nurses aren’t with them … From a staff perspective, single rooms may require
more staffing. When there are two patients in a room, there is less floor space to clean than if all
the patients were in single rooms…From infection control perspective it is nice to have a private
room…Time savings are incurred with single rooms as transfers go down….From the patients’
perspective, single rooms are better. Many prefer privacy. Confidentiality is an issue in semi-
private rooms, even though you can pull the curtain, the patient next to you and family members
of that patient can hear what is being said and the patient knows this.

An optimal mix of single and multiple occupancy rooms depends on medical, social, and
economical factors. In their book on hospital design, Thompson & Goldin (1975) suggested that
a minimum of 25 percent of the rooms in hospitals should be single-occupancy. Occupancy rates
of 80 percent were considered ideal with this type of room density. Service failures were
reduced at this level and the majority of patients requesting admission were accommodated
(Thompson & Goldin, 1975). Bobrow and Thomas (2000) stated that near 100 percent
occupancy rates could be achieved in private rooms. Thus, from an occupancy standpoint, private rooms are more efficient than multi-occupancy rooms.

As mentioned earlier, the nursing unit design is an important aspect of patient room design and layout. Patient rooms cannot be considered in isolation and they need to be evaluated in the context of nursing unit layout. Nursing unit/ward design is vital to the work performed by health personnel. Over the years, different nursing unit and ward designs have evolved, each having distinct features. Florence Nightingale inspired one of the earliest ward designs. The Nightingale ward is a basic long and narrow open ward with beds arranged down each side (Hosking & Haggard, 1999; Tradewell, 1993; Jones, 1985). The goal of this design is to have clear visibility of all patients on the ward. An average of thirty to thirty-two beds are located on this type of ward, with the nursing station is located at one end and the convalescent bay at the opposite end of the ward (Hosking & Haggard, 1999, Tradewell, 1993). Newer designs include the bay ward. This type of design subdivides wards into four-, six-, or eight-bed bays (Hosking & Haggard, 1999).

Various articles have compared the advantages and disadvantages, as well as patient preferences, of the bay and Nightingale wards. Hosking & Haggard (1999) noted, for instance, that Nightingale wards do not enable patients to have their need for privacy met. While bay wards offer more flexibility, privacy, and intimacy, patients have only a limited view of nurses. Anxiety may result if patients are attempting to contact their nurse who, unknown to them, may be unavailable. Other negative aspects of the bay ward include the patient’s sense of confinement and increased noise due to the use of more equipment. In a study conducted in Scotland, patients made the transition from open wards to bay wards. Positive aspects of the bay ward included privacy and isolation in the single-rooms. However, nurses found it difficult to track patients. The open ward, on the other hand, offered patients greater opportunity to interact with each other (Rainey, 1990).

Interestingly, Pattison & Robertson (1996) found the majority of gynecological patients preferred the bay ward to the Nightingale ward. Patients on the Nightingale ward thought privacy and contact with nurses was adequate, but noise levels were higher and sleep disturbances were
greater than on the bay ward. Those on the bay ward were concerned both with a lack of information regarding the whereabouts of nurses and with the activity on the rest of the ward. Patients also mentioned they felt a lack of auditory privacy.

Evidence from these studies does not clearly support the use of one ward over the other. Each has its advantages and disadvantages, such as lack of privacy and increased noise. Patients, however, at least in the case of Pattison & Robertson (1996), preferred to stay on the bay ward despite its limitations. Thus even studies on patients demonstrated that they prefer reduced social density in their recovery spaces.

The efficiency of a nursing unit is determined by its design more than by its size. In particular, circulation design schemes, such as the double-corridor, circular, and square plans, are the most efficient designs, especially if the unit has more than thirty beds (Thompson & Goldin, 1975). Double-corridor designs, followed by the circular and the single-corridor designs, also appear to be the least costly, and costs increase as the number of square feet per bed increases, since construction costs are higher. Traffic costs are lower on smaller units, as travel distances are shorter (Delon & Smalley, 1970).

In terms of unit size, the optimum has been suggested to be between twenty-five and thirty-five beds. Larger units are arguably more efficient, since better staffing patterns are achieved and fewer medicine units and linen rooms are required. Smaller units are advantageous because supervision of patients is better than on the larger units (Delon & Smalley, 1970).

Trites et al. (1968, 1970) studied the impact of nursing unit design on nursing activity. In particular, the nursing units examined were radial, single-, and double-corridor designs.\(^\text{11}\) The radial design was superior to the other designs in terms of nurses’ traveling time. With the reduction in time spent traveling, nurses were able to spend more time with patients. Nurses also

\(^{11}\) In single and double-corridor patterns of ward design, patient rooms are located along one or both sides of the corridor, respectively, and rooms contain four to six beds. A central nursing station is utilized and support spaces are used to supply the unit (Tradewell, 1993). The radial design, on the other hand, centralizes patient care and provides immediate access to the patient (Stichler, 2001).
had fewer accidents and the lowest rate of absenteeism on the radial design unit. Finally, the majority of nurses preferred to work on the radial design unit. The radial design, however, does have some disadvantages. In particular, lateral expansion of this unit is difficult, and this type of design is not able to accommodate an adequate number of private rooms without wasting core space (Cawood, 1993). This type of nursing unit design in not used much anymore because of its inherent staff inefficiencies, awkward leftover spaces in the center, and the irregular shapes of patient rooms (Verderber & Fine, 2000).

A square nursing unit design is another alternative. This design was effectively utilized in a Georgia nursing home. Patient rooms are located along the perimeter of the design and within forty-five feet of the nurse’s station. With bathrooms located along the exterior walls, nurses are better able to observe patients without entering the patient room. Since use of space is maximized, nurses spend less time walking. In turn, morale is high and turnover is low among registered nurses (Fisher, 1982). This type of design is suitable for single-occupancy rooms.

The cluster design encompasses mainly single patient rooms around nursing substations. One nursing station is dedicated as the central one (Tradewell, 1993). This design helps reduce patient travel and the number of people associated with patient care (Jones, 1995). Visualization of patients is increased, and more patient rooms can be located around building peripheries. This design does have disadvantages, though, in that care is decentralized and the social needs of nurses are not met (Stichler, 2001).

The triangular design provides for a maximum number of patient rooms to be located on one floor. This type of design is suitable for single patient rooms. It also reduces travel distance from the nursing station to the patient room. Multiple nursing stations are possible and storage space is centralized. Many current new medical-surgical unit designs are using this type of layout for their nursing units. Negative aspects of this design include limited visibility of patients in remote corners, and difficulty of unit expansion (Stichler, 2001).

The rectilinear design is another possibility for a nursing units. It contains a centralized storage location and is less costly to build than other designs. It has various disadvantages, though,
including increased travel distances by nurses (especially when single occupancy rooms comprise the majority of patient rooms), minimal visualization of patients in remote rooms, and a greater space requirement for patient rooms.

According to Burmahl (2000), flexibility in design is important in the design of patient care environments. Flexible design may include decentralization of the nurses’ station to allow sub-charting stations to be near the patient’s bedside, and to allow for changes to a floor layout within the nursing unit.

_Private and semi-private patient rooms_

Patient privacy is necessary for the treatment of patients. Privacy gives patients 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 (Shumaker & Reizemstein, 1982).

Single-occupancy rooms increase a patient’s privacy (Bobrow & Thomas, 1994, 2000; Solovy, 2002). In addition, Verderber & Fine (2000) noted that, in the 1970s, the U.S. General Accounting Office deemed single-occupancy rooms to be the most cost efficient “in terms of day-to-day operations and initial construction costs” (p. 198). Various hospitals have used private rooms in their designs. For instance, Children’s Hospital in Omaha, Nebraska designed private rooms to look like children’s bedrooms, with enough space to accommodate family members. Privacy is ensured, and the risk of infection is reduced (Hohenstein, 2001). Bobrow & Thomas (2000) also note that single-occupancy rooms can be used for isolation purposes, thus reducing the possibility of acquiring an infection.

Bacon (1920) foresaw the use of private rooms. Early in the 20th century, he noted that private rooms increased flexibility and enabled hospitals to reach maximum bed capacity. He also suggested that private rooms provided patients with more comfort, as better examinations could take place and the patients could control temperatures based on their needs. Visitation could also be scheduled based on the condition of the patients.
Single-occupancy rooms are cost-efficient. In comparison to multiple-occupancy rooms, medication errors and patient transfers are reduced. For instance, in multiple-occupancy rooms, patient transfers can average from six to nine per day. Also, whereas in multiple-occupancy rooms occupancy reaches an average of eighty to eighty-five percent, in single-occupancy rooms occupancy can reach one hundred percent. These factors all contribute to increased savings for the hospital (Bobrow & Thomas, 2000).

Administrators at William Beaumont Hospital in Royal Oak, Michigan noted that while the majority of patients request private rooms, the hospital usually does not have any to offer patients. The semi-private rooms in this facility typically have a ten percent lower occupancy rate than the private rooms. This fact, combined with a savings in transfer costs, makes private rooms more viable. Thus, the hospital is converting seventy to eighty percent of its beds into private rooms (Anonymous, 2000).

The ideal patient room at Providence Portland Medical Center is single-occupancy. “Paired rooms,” with sufficient accommodation for family members and friends were created from one or two rooms on each ward containing connecting doors. These rooms also have the ability to be converted into intensive care units, with enough space to accommodate necessary equipment. Within these rooms, staff have their own area, which includes the tools necessary to treat patients. Families were also included in the room design, and space was allotted for family members to stay and be secondary caregivers.

Private rooms may not be a feasible design in all cases. Mader (2002) suggested that although private rooms help control the spread of infectious diseases, provide a safer, more efficient layout, and increase patient usage, semi-private rooms are advantageous when patient volume is high. Semi-private rooms require less square footage per patient, but issues, such as those relating to gender and the spread of infections, arise in patient placement.

In Fromhart’s (1995) look at long-term facilities, administrators from various facilities had differing opinions on the benefits of private rooms. For one executive in New York, private rooms were seen as the best design because roommate problems are avoided and family members can visit freely and personalize the patient’s room. An administrator in Virginia felt
that semi-private rooms are more cost-effective, while a director in Texas felt that shared-occupancy in an apartment type setting is more cost-effective.

Nurses in England questioned the use of private rooms. Orr, Farrell, and Portman (2002) believed that patients who need constant monitoring would be worse off in private rooms, as monitoring is made more difficult. Staffing would need to be increased and bed capacity would be reduced. Another author, in referring to NHS hospitals, suggested that the open ward is best because of increased patient supervision and greater privacy than on bay wards, and cost-efficiency (Anonymous, 1991).

The research results on the influence of room occupancy or type on pain medication usage were mixed. In a comparative study (Dolce et al., 1985) of narcotic use among back pain patients undertaken to explore whether room type was a predictive variable in narcotic utilization, researchers discovered that patients in private rooms were more likely to use intramuscular request-contingent narcotics than were similar patients in semi-private rooms. This may be due to decreased environmental stimuli in private rooms, combined with patient personality variables and medical staff characteristics. The researchers concluded that type of room might not be the only factor affecting pain medication intake; patients’ own characteristics, along with staff behavior, may also affect medication intake. Other research (e.g., Vernon & McGill, 1961; Zubek, 1969) demonstrated that there is a relationship between decreased environmental stimuli and increased sensitivity to pain. However, other recent studies (e.g., Hill-Rom, 2002) demonstrated that medication intake is less in single occupancy rooms. More research needs to be done in this area to better analyze the relationship between room density and frequency of patients’ narcotics/pain medication usage.

In the year 2000, the Center for Health Design, launched a series of research projects in 10 hospitals that had recently built or renovated facilities according to the Pebble principles. The preliminary results from some of these projects demonstrated the influence of design on patient

\[12\] The pebble project utilizes research to document the impact of the hospital environment on patients, family members and staff. An emphasis is placed on identifying the best hospital practices, as well as continuous improvements in design (McMorrow, 2001).
outcome. Methodist Hospital in Indianapolis and Bronson Methodist Hospital in Michigan are two examples of facilities that are part of this research program and have used the Pebble principles. Clarion Health Partners Inc. renovated the Indianapolis Methodist Hospital’s cardiac wing and redesigned its rooms to be acuity adaptable single patient rooms so that the patients would not have to move from critical care units to medical-surgical units. In these rooms the patients can control both the temperature and lighting within the space. Visibility of patients (by the staff) is increased through the use of an interior window, as is privacy, because the window can be made opaque when needed. Falls and transfers have also decreased substantially.\footnote{The number of patient falls dropped 60 percent in these newly renovated units (Rich, 2002).}

Bronson Methodist Hospital similarly built a facility with 348 private rooms. The preliminary results from the research conducted in this facility demonstrated a greater reduction in hospital-acquired infections than in previous units. 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. In the old facility, the hospital spent around 500,000 dollars per year in patient transfers due to problems with roommates or infection-control issues; this amount has been greatly reduced according to the hospital’s chief executive (Bilchick, 2002; Rich, 2002).

The Barbara Ann Karmanos Cancer Institute was renovated to provide patients with a more pleasant and patient-centered environment. Rooms were made private and larger in size, and lighting and acoustics emphasized. Medication errors and the use of pain medication have been reduced in this facility, thus reducing hospital costs (Bilchik, 2002; Rich, 2002). Though conversion to private rooms did facilitate some of the patient care issues, it was a combination of multiple patient-centered design changes that helped to bring about the above mentioned outcomes. Thus, patient room density needs to be considered in conjunction with other patient-focused design changes in order to achieve therapeutic and cost efficiency goals. Conversion to private rooms (from multi-occupancy rooms) by itself may not provide the desired outcomes.

Saint Louis University Hospital recently introduced a Delirium Room to treat patients suffering from delirium.\footnote{Between 15 and 20 percent of older patients are delirious when they are admitted to a hospital and up to 30 percent become delirious while they are in the hospital (Flaherty, as cited in Solomon, 2003).} This room is part of the acute care for elderly unit, and key to its existence is the provision of a safe environment. Typically, elderly delirious
patients who are agitated are cared for in private or semi-private rooms, isolated from others. They may be placed in physical restraints for protection and given calming medications. However, this new environment is a four-bed room, where 24-hour intensive nursing care is provided without the use of physical restraints and medication to quiet patients is the last-choice treatment. The geriatricians in the hospital found that the elderly patients with delirium do better if they are placed together and cared for in the Delirium Room (Solomon, 2003). Mortality on the unit was zero and patient’s fall rate near zero during a one-year study period, and the use of medications was comparable to or lower than those found in previous studies on delirious patients. Less than ten percent of patients used sedatives (Flaherty et al., 2003). This study demonstrated that in some specific instances where constant supervision is required and patient safety is critical, multi-occupancy rooms may be preferable to single occupancy rooms.

**Variations in single-occupancy rooms**

*Universal Rooms / Acuity Adaptable Rooms*: Within the hospital environment, universal rooms are a current trend in design, especially in hospitals that are promoting patient-centered care and family participation patient healing programs. These rooms are single-occupancy, and their goal is to support the level of care needed by all patients. In other words, any one patient can be placed in any one hospital room and receive the required treatment (Spear, 1997). These rooms are larger than typical hospital rooms, enabling bedside treatment to occur more efficiently. Since patients undergo most of the required procedures in their room, the need to transfer patients is reduced, thus reducing transfer costs (Gallant & Lanning, 2001). Space is also provided for family members to stay, thus incorporating them in patient care (Spear, 1997). Flexibility in these rooms is increased through the use of disabled-access bathrooms. This enables constant patient use of the room (Miller & Swenson, 1995). When these rooms are incorporated into a cluster ward design, the nursing team can readily supervise patients.

Mercy Hospital and Medical Center in San Diego, California is an example of a facility that has incorporated the use of larger rooms. Family members and friends are accommodated in patient
rooms and are involved in the care of the patients. The nursing station is decentralized to make monitoring of patients more efficient (Lumsdon, 1993).

Another term for *universal rooms* is *acuity adaptable rooms*. As the name suggests these single patient rooms serve people at different levels of acuity. The proponents of this type of room argue that, with more and more patients coming to the hospital with a higher level of acuity, this type of room is more suitable to address their varying needs. These rooms are single-occupancy and have enough space to accommodate patients as well as family members. Space is also provided for critical care equipment, and the majority of procedures take place in the room, reducing the need for patient transfers. This, in turn, reduces hospital costs. If bathrooms are located on the exterior wall, space is further increased in rooms, allowing for efficient organization of the room (Gallant & Lanning, 2001).

Acuity adaptable rooms are ideal for the changing trends in hospitals. As the aging population increases, those requiring acute hospitalization will increase as well. The proportion of patients needing intensive care will become larger, and thus services in the Intensive Care Unit will become critical to the hospital (Hamilton, 1999). Acuity adaptable rooms enable patients to receive the critical care needed without being transferred to other units throughout their various phases of treatment. Waiting times transfers are also reduced or eliminated, as they are no longer necessary (Hill-Rom, 2002). One study claimed that medication errors, patient falls, procedural problems, and lab problems are also reduced in acuity adaptable rooms (Hill-Rom, 2002). However, these types of outcomes may be relevant only to the hospital under study and may not be applicable to other settings. More studies on acuity adaptable rooms are required before proposing similar outcomes for other hospitals. When beds are clustered into smaller units (six to nine beds) with decentralized nursing stations, it is expected that visibility of patients will improve and staff will be in close proximity to patients (Hamilton, 1999).

### Patient Preference of Room Type

Mixed results were obtained in studies and surveys of patients’ preferences for room design. Kirk (2002), for instance, interviewed hospice patients in Leeds, England, in regards to their room preference. The majority of patients preferred a single room because of the greater privacy
offered, reduced noise, reduced embarrassment, and improved quality of sleep, and because of being able to have family members stay, and to avoid upsetting other patients. Those preferring a shared room did so because they enjoyed the company and sharing their experiences. Similarly, in the United States, a survey conducted on assisted living facilities resulted in eighty-two percent of those surveyed preferring a private room. Only four percent of people surveyed preferred a shared room. The remaining people did not know or did not have a preference. Of those surveyed, women and those from the western United States were more likely to prefer a private room (Contemporary Long Term Care, 1997).

Other researchers, on the other hand, found results favoring shared occupancy. Of the oncology patients surveyed in a British hospital by Pease and Finlay (2002), thirty-four percent preferred a four-bed bay, while only twenty percent preferred a single-occupancy room. The main factor in selecting the shared room was the wish to avoid isolation. Similar results were found by Reid & Feeley (1973), who conducted a study in the United States. If given the choice, fewer than half the patients surveyed preferred a private room. Double-occupancy rooms were favored because patients had someone to talk to and they felt help was available, if needed, from their roommates. Negative aspects of these rooms mentioned included lack of privacy and high noise levels, especially when patients had visitors.

Previous experience in a hospital influences a patient’s room preference. Spaeth & Angell (1968) found that ophthalmic patients with previous experience in hospitals were nine times more likely to prefer a multi-bed room to a single-occupancy room. Those without previous experience were more likely to prefer a single-occupancy room, but only by a small margin. After being discharged, significantly more patients stated they would prefer multi-bed rooms. The number of patients in a room can impact patient behaviors. For instance, in one study, patients in single-occupancy rooms were more likely to experience loneliness and separation anxiety. Those on open wards experienced higher levels of shame anxiety, but were able to express their hostility to a greater extent (Leigh et al., 1972). When a dormitory style ward was divided into two-bed sections by partitions, patients had more positive attitudes toward the environment and engaged in more social and less passive behavior (Holahan & Seagert, 1973).
Ittleson, Proshansky, & Rivlin (1970) also noted that smaller, private rooms gave patients greater freedom in regards to behaviors and activities chosen in their rooms. Roommate assignment can impact patient anxiety and stress. Kulik, Moore, & Mahler (1993) discovered that patient stress can be reduced if preoperative patients are assigned to rooms with postoperative or non-surgical patients, rather than with other anxious, preoperative patients.

**Patient Satisfaction**

Evaluations made by patients in regards to their hospital rooms affect their satisfaction with their hospital stay. Positive evaluations of their rooms, and of the nursing care received, led to greater hospital stay satisfaction (Gotlieb 2000, 2002). Patients staying in private rooms in a hospital in France were more satisfied with the hospital environment and staff, the information they received, and the quality of care they received (Nguyen et al., 2002).

In a study by Harris et al. (2002), satisfaction with the hospital environment, including the patient room, impacted overall satisfaction. Satisfied patients had larger rooms, windows with a nice view, and easily accessible bathrooms. Their privacy was also protected, and enough space was provided to accommodate family members. In a study by Lawson & Phiri (2000), conducted in England, patients were moved from conventional psychiatric and orthopedic wards to refurbished wards that were mainly composed of single-occupancy rooms. Patients rated their experience and treatment higher on the refurbished wards and were more satisfied with the appearance, layout, and overall design of the unit. Psychiatric patients also stayed for shorter periods of time, while orthopedic patients required lower levels of analgesia.

Morgan and Stewart (1999) studied dementia patients moved from an older, high-density special care unit to a new, low-density special care unit with private rooms. The family members of the residents were pleased with the private rooms because they were able to personalize the rooms and the patients had greater privacy. Due to less stimulation, disruptive behaviors also decreased on the new unit. Some patients did prefer the old ward due to the proximity between patients and staff, as well as the busy atmosphere. Alzheimer’s patients also appear to benefit from the reduced stimulation environment offered by private rooms. Patients in a retirement residence in Iowa were calmer and less agitated when moved to a reduced stimulation unit (Cleary et al., 1988).
Patients appear to prefer single-occupancy rooms. Kaldenberg (1999), for instance, discovered that patients in private rooms were more satisfied with their hospital stay, including their communication with staff members, than patients staying in multiple-occupancy rooms. Patients who had roommates were less satisfied with the noise, cleanliness, and temperature of the room. When roommates are incompatible, hospitals are likely to incur increased transfer costs.

Roommates can also be a source of stress for patients. Specifically, roommates who are unfriendly, have too many visitors, and are seriously ill can have negative effects on other patients (Ulrich, 2003). Patients in single-occupancy rooms large enough to accommodate family members fare better. Social contact reduces stress and improves patient health. Patient falls are also lower in family-centered rooms since patients are likely to have assistance if they need to get up from their beds (Ulrich, 2003).

**Ambient Features of Room Design**
A sense of control over their setting is important to patients during their hospital stay is. The environment should foster the patients’ well being, and it should be convenient and accessible (Lowers, 1999). Poor building design contributes to patient stress. Patients experience a loss of control when their privacy is reduced, when they are not given adequate information, and when they are unable to adjust the lighting and temperature in their rooms (Ulrich, 1999). Environments that are not sensitive to their needs do not enable patients to cope effectively with their stress. This, in turn, can manifest in negative patient outcomes, such as problems with sleeping and noncompliance with medication (Ulrich, 1997). The design of the patient room communicates to patients the attitude of hospital management toward their needs. Patient satisfaction is increased when the environment is pleasant, comfortable, and relaxing (Baker & Lamb, 1992). Sources of patient stress are perceived lack of control, lack of privacy, noise, and crowding (Shumaker & Pequegnat, 1989). Positive patient outcomes are achieved when the hospital environment incorporates natural light, elements of nature, soothing colors, pleasant sounds, and the ability to control one’s environment (Murphy, 2000; Stichler, 2001). The pervasive theme through these articles is the need for a sense of control and reduction of stress for the patient. Single patient rooms provide people with more control over the lighting, HVAC, sound and privacy.
Bed placement is critical in terms of giving patients access to windows in semi-private rooms. Brown (1994) suggested that a problem with semi-private rooms is that both beds are placed on the same wall, thus permitting only one person to be placed next to the window. A solution to this problem is to place the beds on opposite walls or to turn both beds toward the window. A number of researchers (e.g., Beauchemin & Hays, 1996; Neumann & Ruga, 1995; Verderber, 1986; Ulrich, 1984) demonstrated the beneficial effects of a natural view and lighting for hospital patients through the decrease of anxiety, reduction of blood pressure and muscle tension, accelerated recovery time, and minimization of length of stay. Another suggestion was for the room to include two windows, so both patients have equal access to the outside (Anonymous, 1971). Although equal access to a window is not an issue in private rooms, Cys (1999) suggested that beds should have an angular placement so that patients can focus on the view outside rather than on what is taking place in the corridor.

Noise in the hospital environment can heighten patient stress. Tolerance of noise is low during illness, and control of noise is important for the recovery of patients (Hosking & Haggard, 1999b). Excess noise can lead to increased amounts of anxiety, pain perception, loss of sleep, and prolonged convalescence. High noise levels can also impact staff members and increase their burnout levels (Cabrera & Lee, 2000). Hilton (1985) noted that patients recovering in large rooms containing two to eight beds found the noise levels unacceptable. Single-occupancy rooms, on the other hand, had acceptable sound levels. Excess noise can be reduced through the use of sound-absorbing ceilings and floor coverings (Ulrich, 2003). Private rooms aid in the reduction of noise. With fewer patients in one room, the amount of noise produced is lower. Duffin (2002) noted that less exposure to noise can facilitate a patient’s recovery. Music can also help reduce patient stress, and patients should be encouraged to listen to music when possible (Lowers, 1999; Ulrich, 1997; Weber, 1995).

Patients can listen to music in private rooms without disturbing their roommates, as would be the case in semi-private rooms. Empirical research has addressed the issue of noise production in hospital rooms. Hilton (1985) conducted a study at three hospitals in a large metropolitan area in Canada. He discovered that noise levels were lower in single-occupancy rooms, whereas rooms consisting of two to eight patients produced unacceptable sound levels. Baker et al. (1993)
studied the various types of sounds on a critical care unit. They found that sound levels were highest during room conversation and lowest for background sound. There is a greater tendency to conversation if the room is semi-private or multi-occupancy. Other sources of noise included hall conversation, furniture moving, alarms, and toilet flushing. Two of these four sources are more prevalent in multi-occupancy rooms.

Crowding
Crowding can contribute to higher blood pressure. In a study of inmates, those staying in higher occupancy cells were more likely to have high blood pressure than those in lower occupancy cells (D’Atri, 1975). Crowding also impacts socialization. In a study conducted in a college dormitory with short and long corridors, those on the long corridor with more residents were more likely to perceive dormitory life as hectic and less controllable. They also found it difficult to develop small groups (Baum & Davis, 1980). The elderly living in long term care institutions need enough space to have their needs for privacy and territoriality met. If their needs are not met, patients often exhibit a sense of loss of personal control and a weakened personal identity. The use of private rooms and social lounges often minimizes the patients’ sense of crowding (Tate, 1980).

These studies on crowding in other types of environment have implications for inpatient hospitals, where people’s physical and/or mental health status may make them more sensitive to issues of crowding. These studies imply that private rooms are beneficial to patients. In private rooms, patients are not subject to others, and thus have a greater opportunity to control their environment such that its negative effects, such as high blood pressure and a loss of personal identity, are greatly reduced.

Other Features of the Environment
As mentioned previously, a patient’s sense of control is crucial to recovery. Control can be exercised through various means. For instance, patients can be in control of lighting in the room through the use of bedside dimmers, and they have more flexibility in controlling the light and sound level in their room if they are in single occupancy rooms. Patients should be able to control the temperature in their rooms, since temperatures that are incongruent with the patients’ needs may result in stress (Shumaker & Reizemstein, 1982; Williams, 2001). Other controls that
can be added in patient rooms are bedside window shades and television controls (Murphy, 2000). Control is greater in private rooms, as patients can adjust settings according to their needs, without having to be concerned about the needs of others. Ulrich (1999) suggests the use of a healing garden, which includes elements of nature such as green vegetation, flowers, and water, may aid in the reduction of stress experienced by patients during their hospital stay.

**CONCLUSION**

Private rooms are the trend in hospital 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, the above discussion of hospital costs, infection control, falls reduction, and therapeutic impacts as they relate to room occupancy demonstrates that a simple consideration of room occupancy does not provide a complete picture of patient care, cost or infection reduction issues. Room occupancy issues need to be considered along with other patient care issues, other environmental changes or changes in management policy in order to bring about desired outcomes. A summary of the above discussion is presented in brief bulleted format below followed by a summary chart (see Table 1) illustrating issues that are related to room density.

*First and Operating Costs of Hospitals*

- Literature focusing on comparative first costs for single and multi-occupancy rooms is scarce. There are a few articles that address operating costs in patient rooms in relation to transfer costs/patient stay (Cho, Ketefian, Barkauskas, & Smith, 2003; Smet, 2002).
- In general, the literature addressing cost issues addresses the health care delivery process and methods of accurate cost estimates (Dexter & Macario, 2001; Cleverley, 2002; Garattini, Giuliani, & Pagano, 1999; Li & Rosenman, 2001; Thompson & Goldin, 1975).
- 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 (Hill-Rom, 2002; Ulrich, 2003), higher bed occupancy rates (Bobrow & Thomas, 2000) and reduction in labor cost. However, this reduction in cost can only be achieved when conversion to single rooms is paired with other healing environment design principles.

- 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). In multiple-occupancy rooms, occupancy reaches an average of eighty to eighty-five percent, whereas in single-occupancy rooms, occupancy has the ability to reach one hundred percent. This contributes to increased savings in operations costs (Bobrow & Thomas, 2000).

- A patient’s length of stay is associated with hospital costs. Research demonstrates that patients’ length of stay in private rooms is less, 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**

- Infected patients or patients highly susceptible to infections need to be isolated in private rooms with proper ventilation systems and barrier protections to stop infection from spreading or reduce the possible development of new infections (Anderson, Bonner, Scheifele & Schneider, 1985; Muto et al. 2000; O’Connell & Humphreys, 2000; Sehulster & Chinn, 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.
Prolonged hospitalization is a risk factor for hospital-acquired infections. Additionally, intra-hospital spread of infection may result from transferring patients to more than one ICU or more than one floor during their hospitalization. We know from other studies that hospital stay is reduced if patients stay in single occupancy rooms, and there is less need for transfer in these types of rooms (Mulin et al., 1997).

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).

Burn patients in nursing units with a majority of single-occupancy rooms are less likely to acquire an infection than those in an open wards (Shirani, McManus, Vaughan, Pruitt, & Mason, 1986).

Studies have demonstrated that Hepatitis C virus is often transferred from one patient to another, especially in Hematology wards when patients with the virus are not isolated. The researchers emphasized the need for isolation of patients to reduce spread of HCV in hospitals (Allander et al., 1995, Silini, et al., 2002).

Studies have demonstrated that hospital-acquired diarrhea may transmit between patients sharing rooms and toilets. It is often recommended that patients with diarrhea be isolated (Korpela et al., 1995).

A recent research demonstrated some negative consequences of isolation. Isolated patients were twice as likely as non-isolated patients to experience an adverse event during their hospital stay. For instance, supportive care failures, such as falls and peptic ulcers, were more likely among them as were incomplete recordings of their vital signs. Hospital stays were also longer for isolated patients and their dissatisfaction with their treatment was greater than non-isolated patients (Stelfox, Bates, & Redelmeier, 2003). This study points to the need of more in-depth research on the relationship between patient care issues and patient isolation.

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, van der Meulen, de Haan, van Straten, & Limburg, 1997).
Most falls occur in patient rooms, among elderly patients, when patients are alone and while patients are attempting to go to the bathroom (Hendrich, Nyhuis, Kippenbrock, & Soja, 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 (Ulrich, 2003).

Although patients in double rooms can assist each other in the event of falls, double rooms also pose a greater challenge for one of the two patients in accessing the bathroom (Pullen, Heikaus, & Fusgen, 1999).

**Health care Facility Management and Hospital Design and Therapeutic Impacts**

- Single-occupancy rooms increase patients’ privacy. Privacy gives patients 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).

- Research indicates that the influence of room occupancy or type on 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. On the other hand, other research demonstrated that pain medication intake is less in single occupancy rooms (Dolce, Doleys, Racynski, & Crocker, 1985; Lawson & Phiri, 2000).

- It is claimed that health care professionals have more private and, in many cases, more thorough consultations 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. More research is required before providing more definitive recommendations.

- Mixed results were obtained in studies and surveys of patients’ preferences for room design. A majority of patients prefer single rooms because they offer greater privacy, reduced noise, reduced embarrassment, improved quality of sleep, an opportunity for
family members to stay, and less likelihood of upsetting other patients (Douglas, Steele, Todd, & Douglas, 2002; Kirk, 2002; Pease & Finlay, 2002; Reed & Feeley, 1973).

- Some patients prefer shared rooms because they enjoy the company and sharing of experiences, as well as the potential for help from roommates, if needed. Patients in single-occupancy rooms are more likely to experience loneliness and separation anxiety, whereas patients in open wards experience higher levels of shame and anxiety (Leigh, Hofer, Cooper, & Reiser, 1972).

- Patient stress can be reduced if preoperative patients are assigned to postoperative or nonsurgical roommates (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 single-occupancy, and their goal is to support the level of care needed by all patients. Waiting times for patient transfer are reduced or eliminated, as transfers are no longer necessary. Space is also provided for family members to stay, incorporating them in patient care. 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. Acuity adaptable rooms are a fairly new development in the area of hospital room designs. More detailed study with examples from multiple hospitals is required before drawing specific conclusions.

- Studies on the patient satisfaction issue demonstrated that patients in private rooms were more satisfied with their hospital stay, including their communication with staff members, than patients staying in multiple-occupancy rooms. Patients who had roommates were less satisfied with the noise, cleanliness, and temperature of the room (Kaldenberg, 1999, Ulrich, 2003).

- Patient satisfaction is increased when the environment is pleasant, comfortable, and relaxing. Sources of stress for patients are: perceived lack of control, lack of privacy, noise, and crowding (Shumaker & Pequegnat, 1989). 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).

- One problem that may arise in semi-private rooms is that both beds may be placed on the same wall, thus permitting only one person to be placed next to the window (Brown, 1994).

- Less exposure to noise in private rooms can facilitate a patient’s recovery. Excess noise can lead to increased amounts of anxiety, increased pain perception, loss of sleep, and prolonged convalescence (Baker, Garvin, Kennedy, & Polivka, 1993; Cys, 1999; Hilton, 1985).

- Music can also help reduce patients’ stress. Patients can listen to music in private rooms without disturbing their roommates, as would be the case in semi-private rooms (Cabrera & Lee, 2000).

- Crowding can contribute to higher blood pressure. The use of private rooms and social lounges often minimizes the patients’ sense of crowding (Baum & Davis, 1980; D’Atri, 1975).
TABLE 1: Categories, issues, and findings related to single vs. multiple occupancy patient rooms based on the literature review

<table>
<thead>
<tr>
<th>Category</th>
<th>Room Occupancy</th>
<th>Issues &amp; Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>COST</strong></td>
<td>Single-Occupancy Room</td>
<td>• Operating costs ↓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• First costs ↑</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Occupancy rates ↑</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Length of stay ↓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Medication errors &amp; costs ↓</td>
</tr>
<tr>
<td></td>
<td>Multi-Occupancy Room</td>
<td>• Operating costs (inconclusive)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• First costs ↓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Occupancy rates ↓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Length of stay ↑</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Medication errors &amp; costs ↑</td>
</tr>
<tr>
<td><strong>INFECTION CONTROL AND FALLS</strong></td>
<td>Single-Occupancy Room</td>
<td>• Rate of nosocomial infection ↓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Patient transfers ↓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Patient length of stay ↓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Infections in burn patients ↓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• HCV transmission between patients ↓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Transmission of hospital-acquired diarrhea ↓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Falls in patients requiring supervision ↑</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Falls in elderly when provisions are taken ↓</td>
</tr>
<tr>
<td></td>
<td>Multi-Occupancy Room</td>
<td>• Isolation for infected patients (inconclusive)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Infections when patients are transferred ↑</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Transmission of hospital-acquired diarrhea ↑</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Patient length of stay ↑</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Access to bathrooms ↓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Falls in patients requiring supervision ↓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Falls in elderly when provisions are taken ↓</td>
</tr>
<tr>
<td>Category</td>
<td>Room Occupancy</td>
<td>Issues &amp; Findings</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------------</td>
<td>-------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>Single-Occupancy</td>
<td>▪ Privacy ↑</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Pain medication (inconclusive)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Patient consultation with physician (inconclusive)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Patient preference for room design (inconclusive)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Noise level ↓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Sleep disturbances ↓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Acuity-Adaptable rooms (inconclusive)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Patient satisfaction ↑</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Patient control ↑</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Crowding ↑</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Stress reduction through music ↑</td>
</tr>
<tr>
<td></td>
<td>Multi-Occupancy</td>
<td>▪ Privacy ↓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Pain medication (inconclusive)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Patient consultation with physician (inconclusive)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Patient preference for room design (inconclusive)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Benefit of roommates (inconclusive)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Noise level ↑</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Sleep disturbances ↑</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Patient satisfaction ↓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Patient control ↓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Crowding ↑</td>
</tr>
<tr>
<td></td>
<td></td>
<td>▪ Stress reduction through music ↓</td>
</tr>
</tbody>
</table>

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


Contemporary Longterm Care (August, 1997). A room of one’s own. *Contemporary Longterm Care, 20*(8), 14.


Shelton, W. (September, 2003). Personal interview with manager, Epidemiology and Employee Health Swedish Medical Center, Seattle, Washington.


Smet, M. (September, 2002). Cost characteristics of hospitals. *Social Science & Medicine, 55*(6), 895-906.


Tate, J. (1980). The need for personal space in institutions for the elderly. *Journal of Gerontological Nursing, 6*(8), 439-449.


