to design and build health care facilities founded on research or the best available information, ensuring that the relatively permanent physical environment facilitates the delivery of quality care, thereby improving patients' outcomes and safety.2

Review of the Literature on EBD in Critical and Acute Care

Substantial support exists for the view that a health care structure itself affects quality of care, patients' safety and satisfaction, as well as staff satisfaction and service efficacy.3

In a report to the Center for Health Design funded by the Robert Wood Johnson Foundation, Ulrich and associates4 identified more than 600 studies that link hospital design with clinical outcomes. Table 1 provides key references related to patients' outcomes after acute hospitalization on medical-surgical or intensive care units. Authors identified several design standards that should be universally adopted: use of single-bed rooms in almost all situations, natural light and views of nature, navigation or “wayfinding” systems for...
outpatients and visitors, and unit layouts that reduce staff walking time, thereby increasing time for patient care. Single rooms were associated with lower rates of nosocomial infection, fewer medication errors, decreased noise, greater privacy for patients, improved social support by patients’ families and significant others, improved communication between patients and staff, and an overall increase in patients’ satisfaction with care.\textsuperscript{5-26}

Natural light in patient care areas reduced agitation in elderly patients, decreased length of stay, lessened the need for pain medication, and reduced depression.\textsuperscript{27,31} Researchers\textsuperscript{34} reported that the cost of an inefficient system for navigation in a major regional hospital was more than $220,000 per year or $448 per bed. Much of this cost involved 4500 hours of hospital staff other than information staff giving directions. Views of nature from patients’ rooms and during procedures reduced stress and pain,\textsuperscript{35,36} and redesigned nursing units improved work efficiency.\textsuperscript{37}

In 1999 and 2001, the Institute of Medicine reported on numerous deficiencies in the existing health care system in 2 landmark reports. The first report “To Err Is Human” exposed the incidence of preventable medical errors.\textsuperscript{38} Contributing factors included the decentralized and fragmented nature of our delivery system and lack of attention to error prevention by health care organizations and health care providers. Most often, however, errors were caused by ineffective systems, processes, and conditions. In “Crossing the Quality Chasm: A New Health System for the 21st Century,”\textsuperscript{40} it was further reported that the current health care delivery system was not patient-centered, and was in fact ineffective, inefficient, untimely, and inequitable.

Evidence-based design addresses a number of deficiencies in the health care delivery system.\textsuperscript{41} For example, patient-centeredness refers to the recognition of patients’ preferences and values. In relation to physical environment, patient-centered designs include variable acuity rooms that allow patients to be cared for with fewer transfers, single-bed rooms, accommodations for family members, and access to information. Ineffectiveness refers to underuse and overuse of tests and other necessary services. In relation to physical environment, effectiveness can be enhanced by ensuring adequate lighting, multiple unit workstations, and noise reduction. Efficiency is addressed through the use of rooms for patients and unit layouts that are standardized. Timeliness of care is influenced by the size and shape of patient units. Equity can be addressed by assessing and planning for current and projected population demographics and their needs early in the design process.\textsuperscript{41}

Rashid\textsuperscript{42} examined intensive care units (ICUs) built between 1993 and 2003 and considered to be best-practice units by the Society...
of Critical Care Medicine, the American Association of Critical-Care Nurses, and the American Institute of Architects. Although characteristics supported by EBD were found, most units lacked consistent design solutions for improving outcomes for patients and staff. Family presence was restricted, and waiting areas were located outside the unit. Layout issues and mixed-use areas contributed to staffing and safety problems. Although the design of some units was not optimal, newer ICUs had best-practice design features such as private rooms, free-standing beds with access from all sides, hand-washing sinks, improved waste disposal facilities, and natural light to facilitate vision and circadian rhythm stability.43,44

Research on EBD is evolving. Hospital administrators and architects may use some characteristics that match EBD recommendations but not use others because of physical and/or budgetary restrictions. Therefore, it is important to assess both positive and negative outcomes of unit design to help identify the most beneficial elements. It is well recognized that patients’ satisfaction is a valuable indicator in evaluating quality of care. The purpose of this survey was to examine responses of patients and their families to EBD features incorporated in a new heart center.

**EBD Features of New Heart Center**

The Cleveland Clinic, a large Midwest tertiary-care medical center in Cleveland, Ohio, opened a 395-bed heart and vascular hospital in October 2008 on the main campus of its system, with all beds providing ICU or telemetry/intermediate care services. In the planning phase, many aspects of EBD were considered. All rooms for patients were designed for single-bed use. Other EBD features include expansive windows, pullout futons supporting unrestricted family presence at the bedside, footwalls containing a large, easy-to-see flat screen television (Figure 1), large private bathrooms, headwalls with recessed space to stow medical equipment out of sight, and additional storage for patients and staff hidden behind room walls (Figure 2). Bathroom lights are motion sensitive. The shower area is spacious and entered by crossing a very low step. Patients can enter the shower by using a wheelchair or walker if necessary. In addition to a main nursing station, nursing units have auxiliary workstations. Nursing units also have multiple clean and dirty utility rooms and medication and supply rooms designed to decrease staff walking time and noise. ICU rooms have large multi-position lounge chairs and bedside toilet/sink units that appear as a seat when not being used for elimination needs (Figures 3 and 4).

The large bright main entrance of the stand-alone building was designed to facilitate patient flow and navigating through the building. Information desks are clearly visible, and numerous trained and highly visible “Red Coat” volunteers are strategically positioned and available to assist patients, patients’ families, and health care workers. Directories are located outside elevators on each floor. Lounge areas are spacious with large windows, multiple seat groupings partitioned for privacy, multiple large-screen televisions, refrigerators, and a staffed information desk to facilitate communication between families and health care teams. A rooftop glass-walled observatory provides a scenic respite for patients, their families, and staff.

When patients were moved from old to new hospital rooms, a rare opportunity existed to assess the
perceptions of patients and their families of the differences between the old and new environments of care. The goal was to determine what aspects of the physical environment were perceived as improved, unchanged, or worsened in order to anticipate the care needs of future patients and their families and enhance satisfaction with the physical environment.

**Methods**

This project was exempt from the oversight of the institutional review board under the federal exemption category 2, as this project was intended to be a quality assessment of the perceptions of patients and their families related to environment of care.

Data collection was guided by asking patients and their family members, when present, to respond to the following open-ended questions: (1) What have you noticed that is different in this environment compared with the old unit? (2) Do these differences affect you and if so, how? (3) What improvements are still needed? (4) Has the care you’ve received changed since coming to the new building? (5) Is there anything else about the new building we should know? Data collection was anonymous and confidential. Participants’ responses did not place them at risk because data were not used in patient care or shared with nursing staff. Further, follow-up questions were not elicited to determine respondents’ meaning or to gain additional insights.

Questions were developed by 2 clinical nurse specialists and 2 nurse managers and were intended to be broad in scope and to elicit personal descriptive responses. Using a convenience sample of patients and family members who were awake and alert, 1 nurse and 1 patient service associate transcribed verbal responses after providing the rationale for data collection. All patients and their families were interviewed within 1 week of the move from their old to their new room. Five general environmental topics emerged: privacy, space, noise, light, and overall atmosphere or “feel.”

In addition to data collected from interviews, relevant data on patients’ satisfaction from the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) and Press Ganey surveys were examined. The nationally used HCAHPS and Press Ganey surveys are valid, reliable, and standardized, and HCAHPS results are publicly reported. The HCAHPS survey asks discharged patients 27 questions about their hospital stay; however, we assessed only data related to environment of care, as noted in results reported in Figure 5. The Press Ganey survey asks additional

![Figure 2](image-url)
questions about admission, room, meals, nurses, physicians, visitors and family, personnel issues, tests and treatments, and overall assessment using a Likert-like scale with 5 points, from 1 (very poor) to 5 (very good). As with the HCAHPS survey, we assessed only the data related to the patient’s experience with the room (pleasantness, décor, and temperature) and the comfort of patients’ visitors and family with accommodations because these data reflected the goals of the project.

The HCAHPS and Press Ganey surveys are administered by Press Ganey to a random sample of adult patients across medical conditions between 48 hours and 6 weeks after discharge from the hospital. Per requirements, patients are surveyed throughout every month of the year. Data for this report were provided by a member of the hospital’s Quality Practice and Safety Institute. Data collection on the nursing units of the old heart center occurred from January through September 2008. Data from the new heart center were collected during the same time frame 1 year later, from January through October 2009. Data on patients’ satisfaction represented responses from patients on four 36-bed telemetry units before the move and six 24-bed telemetry units after the move. Interview responses were reviewed verbatim and categorized descriptively on the basis of the care themes raised by the patients and their family members.

Results

The old heart center had 244 beds consisting of 28 coronary care and heart failure ICU beds, 108 cardiothoracic surgical telemetry beds, and 108 cardiac medical telemetry beds. The new heart center has 395 beds consisting of 34 coronary care and heart failure ICU beds, 76 cardiothoracic ICU beds, and 285 telemetry beds. Cardiothoracic surgery ICU patients were not included because the length of stay in that environment is usually less than 24 hours. Patients were not moved on 1 day; rather moves from the old to new environment occurred on consecutive Saturdays during a 4-week period. Based on a 90% occupancy in the old facility on the days that patients were moved, and assuming an additional 10% of patients moved would not meet eligibility criteria to be interviewed, our sample of 103...
hospitalized patients and families who participated represented 62.7% of the available population. No other participant descriptors were collected.

**Characteristics Eliciting Satisfaction With the New Physical Environment**

Patients and their families overwhelmingly reported being pleased with the overall room design (Table 2). When responding to the first 2 questions of the survey (“What have you noticed that is different in this environment compared to the old unit” and “Do these differences affect you and if so, how?”), nearly a third of patients commented on having a private room.

Some stated they did not have to worry about “bothering anyone” or invading their roommate’s privacy. A female patient stated “I get up earlier than most people; now I don’t have to worry about disturbing my roommate . . . I can watch TV in the morning.” Others stated, “Privacy is big”, and “The private room is a blessing.” Patients reported that it was easier to talk with their family members and that they could rest or sleep when they wanted. Patients also commented on being able to adjust the room thermostat to their comfort level.

Patients and their families reported that the new rooms were quieter, more spacious, less confining, less cluttered, and allowed more family visitation. One elderly man commented, “I can get up so much easier, there is nothing to bump my feet on.” A female patient stated that she felt “less confined; [it is] easier to maneuver.” Others stated that they felt more independent and were less stressed about getting up to go to the bathroom. The large bathroom with motion-sensitive lighting was also a positive feature. Some patients were pleased that they could “get a chair in there to wash” and that it was easier to maneuver in the low-step shower. The addition of a futon was appreciated by patients and their family members. Family members stated that they were very pleased that they had a place to rest or sleep in the patient’s room. Large windows elicited nearly unanimous approval. Comments included “I can see better,” “beautiful windows,” “the big windows are lovely,” “nice view,” “lots of light,” “happy for the view,” “big windows are more cheerful,” and “don’t need to use the lights.”

The overall atmosphere was described by patients as being less like a hospital and more like home or a hotel. Most patients reported

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**Table 2** Satisfying design features of patients’ rooms (N = 91)

<table>
<thead>
<tr>
<th>Satisfying features</th>
<th>% of patients commenting on the feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Privacy of room; no roommate</td>
<td>31.9</td>
</tr>
<tr>
<td>Room size</td>
<td>29.7</td>
</tr>
<tr>
<td>Bathroom</td>
<td>26.4</td>
</tr>
<tr>
<td>Reduced noise</td>
<td>23.1</td>
</tr>
<tr>
<td>Television</td>
<td>23.1</td>
</tr>
<tr>
<td>Window size/view</td>
<td>19.8</td>
</tr>
<tr>
<td>Lighting</td>
<td>16.5</td>
</tr>
<tr>
<td>Storage</td>
<td>5.5</td>
</tr>
<tr>
<td>White walls</td>
<td>4.4</td>
</tr>
<tr>
<td>Television control; artwork; and electrical outlets</td>
<td>1.1 (each)</td>
</tr>
</tbody>
</table>

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Figure 5 Hospital Consumer Assessment of Healthcare Providers and Systems “always” or “very good” scores before (April-September 2008) and after (January-October 2009) change in environment. Rating options for quiet and cleanliness were never, sometimes, usually, and always; rating options for all other factors were very poor, poor, fair, good, and very good. Data on the quiet and cleanliness factors were provided from January through September 2008.
that they felt happier, less anxious, more relaxed, less stressed, more comfortable, and more independent. Families also reported that they felt more relaxed, more comfortable, and happy that the room could accommodate overnight visitors.

**Characteristics Eliciting Dissatisfaction With the New Physical Environment**

Because patients had spent time in an older semiprivate room before being transferred to the new heart center environment, they were able to compare elements of the environment in the old and new space that were unchanged, prompted dissatisfaction, or needed to be improved (Table 3). Light controls for the room were an issue for some. Patients reported dissatisfaction with the fact that they could not access all light controls in the room while in bed. One patient was concerned about unlabeled red wall switches, asking “what happens if I bump them?” One female patient was concerned that the bathroom was a little farther away. One man suggested that an extra handicap bar by the toilet would have been helpful.

Although the large-screen television was well received, a number of patients reported that the controls were difficult to use and allowed the user to scroll through the channels only in 1 direction. One patient stated that Internet access and a bedside keyboard would have been very desirable. A numberless clock positioned at the side of the bed was reported to be difficult to see and read. A wall calendar, a small refrigerator, and hand cleaner for family members were requested by a few patients.

Although the rooms themselves were quieter, hallway noise continued to be a problem. The size and design of patients’ chairs was a concern for many (see chair in Figure 1). A streamlined office-style chair with open arms had been selected by the designers. Patients reported that they did not feel comfortable sitting in them. Comments included that they were “unfriendly . . . can’t sit up in them,” “my wires and gown get caught,” “not enough padding on arms,” “no foot rest,” “[I’m] worried about sitting in those chairs,” and “don’t want to get out of bed—don’t like the chairs.”

Finding their way around remained an issue for many visitors. The “Red Coat” volunteers were lauded for their assistance but others reported that the facility was difficult to navigate, that more directories were needed, and that it was too much walking.

**Nursing Care Changes With a Change in Environment**

When asked “Has the care you’ve received changed since coming to the new building?” patients and their families overwhelmingly reported being very pleased with the care in both the old and new heart centers. Some noted that in the new rooms, nurses “move[d] in and out more smoothly,” were “more attentive,” and were “more responsive, in better spirits.”

**Patients’ Satisfaction With a Change in Environment**

In addition to face-to-face surveys, HCAHPS data were examined before and after hospital opening for changes in cardiac patients’ perceptions of their hospital experience. Improvements were noted in every area of environment of care when old and new facility experience responses were compared (Figure 5). For example, when asked how often the area around the room was quiet at night, patients reported it was “always” quiet 59.2% of the time in 2009 compared with 34.5% of the time in the old heart center. When asked about the pleasantness of room décor, patients reported “very often” 66.8% of the time in the new environment of care compared with 28.9% in the old heart center environment.

**Discussion**

Design decisions made today may affect care delivery for decades. With the current unprecedented surge in hospital construction, it is imperative that environmental characteristics influencing the well-being of patients, visitors, and staff be identified and incorporated in

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**Table 3** Dissatisfying design features of patients’ rooms (N = 91)

<table>
<thead>
<tr>
<th>Dissatisfying features</th>
<th>% of patients commenting on the feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Television control</td>
<td>16.5</td>
</tr>
<tr>
<td>Chairs</td>
<td>12.1</td>
</tr>
<tr>
<td>Noise</td>
<td>9.9</td>
</tr>
<tr>
<td>Clock placement and face (no numbers on face)</td>
<td>5.5</td>
</tr>
<tr>
<td>Bathroom</td>
<td>4.4</td>
</tr>
<tr>
<td>Signage</td>
<td>4.4</td>
</tr>
<tr>
<td>Televisions</td>
<td>3.3</td>
</tr>
<tr>
<td>White walls</td>
<td>3.3</td>
</tr>
<tr>
<td>Lighting</td>
<td>2.2</td>
</tr>
<tr>
<td>Private room; room size; window size or view; artwork, storage; and electrical outlets</td>
<td>1.1 (each)</td>
</tr>
</tbody>
</table>
future hospital designs. Based on the Institute of Medicine’s findings regarding effects associated with environment-of-care design features, hospitals built in the 1950s to 1970s are outdated and inadequate in meeting today’s health care demands and have significant safety issues and inefficiencies. In reports from the Pebble Project, a research initiative of the Center for Health Design, patients’ outcomes improved when EBD concepts were implemented. Topics specific to patient safety, such as medication errors, infection, pressure ulcer development, cognition, and falls, were not raised by patients when answering questions nor were those topics assessed objectively or through review of quality data. Structural elements of EBD that were most often vocalized as satisfiers were private rooms, larger private bathrooms, and large windows with a view. These same structural EBD features could enhance patients’ safety in relation to falls and cognition.

Satisfaction of patients and their families with the hospital experience was enhanced when EBD elements were incorporated in the structural plan. Casscells et al found that patients and their families strongly endorsed private rooms, space in the patient’s room for family members to stay overnight, lighting and temperature controls, and means for maintaining awareness of the outside world through television, books, and papers. In our quality assessment, quality scores based on HCAHPS and Press Ganey data improved in the new heart center environment, reflecting enhanced patient and family satisfaction.

Knowledge gained from patients and their family members can be applied by nurses working in new or older critical care, intermediate, and telemetry care areas. Although many design elements were perceived as improvements, some features of the new heart center were not optimal. Overall functional status and timely discharge may be affected if bedside chairs are uncomfortable or do not offer support features needed to encourage use. Because early mobility and general activity are critical in avoiding functional decline, lessons learned about the comfort of chairs (and other furniture) could help determine if furniture choices facilitate mobility.

Availability of an easy-to-see television can improve sensory stimulation and help patients remain oriented and aware of local and national events outside of the hospital. In addition, the television is an educational feature if used to provide patients with new knowledge about their illness or plan of care. Thus, an ability to use controls independently may affect knowledge, emotions, and space-time orientation as well as provide entertainment. Finally, in our study, the inability to control room lighting was dissatisfying. Lighting can affect circadian rhythm and sleep patterns. Ensuring a patient’s ability to control lighting independently may be a factor in achieving optimal sleep and recovery. Offering patients meaningful sources of sensory stimulation and a sense of control of the environment can help maintain patients’ orientation, promote normal sleep patterns, and improve satisfaction with care. Table 4 provides a list of EBD considerations that can apply to new, remodeled, or current environments of care.

Table 4 Nursing implications for evidence-based design

<table>
<thead>
<tr>
<th>Implication</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Be aware of the influence of the physical environment on patients, patients’ families, and staff</td>
</tr>
<tr>
<td>• Arrange for private rooms whenever available</td>
</tr>
<tr>
<td>• Be aware and, if possible, remedy factors affecting physical privacy and communication privacy of patients and their family members</td>
</tr>
<tr>
<td>• Encourage and facilitate family visitation in or near patients’ room</td>
</tr>
<tr>
<td>• Provide patients with control over lighting, temperature, and television, radio, or other controls</td>
</tr>
<tr>
<td>• Minimize noise</td>
</tr>
<tr>
<td>• Enhance natural lighting and views of nature by opening window curtains/blinds whenever possible</td>
</tr>
<tr>
<td>• Ensure safe walkways in patient rooms and bathrooms by removing/moving medical equipment or other impediments</td>
</tr>
<tr>
<td>• Have patients provide feedback on comfort of chairs, pillows, blankets, and other supplies or equipment that can be updated for comfort and support. For example, assess chair features for patients with multiple intravenous catheters, telemetry wires, or other entangling attachments</td>
</tr>
<tr>
<td>• Consider how much of your time is spent walking (gathering supplies, accessing computers, etc) and how this can be lessened</td>
</tr>
<tr>
<td>• Participate in committees planning changes in the design of nursing units</td>
</tr>
</tbody>
</table>

Evidence-based design is cost-effective. In an analysis of 1-time capital expense compared with reasonable operational savings, increased market share, and philanthropic donations, Sadler et al indicated that initial additional
capital costs would be recovered in 2 to 3 years. In another in-depth analysis, Berry et al demonstrated that estimated savings and revenue increases generated from a building constructed according to EBD guidelines would result in nearly recapturing the additional investment in the first year. Ultimately, construction costs associated with EBD can be balanced by a short time to break-even. Because our occupancy rate was historically high for heart center services (consistently >95%), occupancy rate comparisons were not conducted.

In 2006, the American Institute of Architects developed guidelines for new hospital construction that were based, in part, on EBD data. These guidelines are currently used by 42 states and the US federal government. Not only does EBD create a visually appealing environment of care, but EBD has been associated with improved clinical outcomes, including aspects of patient safety, and directly addresses many deficiencies identified by the Institute of Medicine. Patients’ independence and safety, control over the environment, and overall satisfaction with care provided during a hospital stay can be improved with EBD. Interventions that aid in reducing dissatisfying aspects of the environment may enhance patients’ care and further improve clinical outcomes, safety, and satisfaction with the hospital experience. 

References

Financial Disclosures
None reported.


Learning objectives: 1. Discuss the concept of evidence-based design in health care environments  2. Identify evidence-based design features associated with improved patient care  3. Recognize the role of physical environment in influencing patient outcomes

1. Which of the following is an effect of single (private) hospital rooms?
   a. Reduced nosocomial infections  
   b. Increased patient falls  
   c. Decreased communication between patients and staff  
   d. Reduced social support

2. Which of the following is associated with natural light in patient care areas?
   a. Increased agitation in older adults  
   b. Increased analgesic use  
   c. Increased length of stay  
   d. Reduced depression

3. Which of the following design standards is primarily associated with decreased stress and pain during procedures?
   a. Single-bed rooms  
   b. Views of nature  
   c. Natural light  
   d. Unit layout

4. In relation to physical environment, what can enhance patient-centered effectiveness?
   a. Family member accommodations  
   b. Minimizing laboratory draws  
   c. Noise reduction  
   d. Variable acuity rooms

5. Standardized unit layouts primarily address patient-centeredness by which of the following?
   a. Providing service effectiveness  
   b. Being efficient  
   c. Displaying equity  
   d. Demonstrating timeliness

6. What deficiency in health care delivery can be addressed by assessing and planning for current and projected population demographics and their needs early in the design process?
   a. Untimeliness  
   b. Inequities  
   c. Inefficiencies  
   d. Ineffectiveness

7. In addition to overall atmosphere, privacy, and space, what other general environment topics of focus emerged in this survey?
   a. Family presence and emergency preparedness  
   b. Communication and infection control  
   c. Music and art  
   d. Noise and light

8. Compared with 34.5% of the time in the old heart center, how often did patients report it was “always” quiet at night in 2009?
   a. 39.2%  
   b. 49.2%  
   c. 59.2%  
   d. 69.2%

9. What is correct about evidence-based design in health care?
   a. Overall hospital size is an important aspect of evidence-based design.  
   b. The effects of evidence-based design are geared toward patient, not staff, satisfaction.  
   c. Evidence-based design addresses deficiencies identified by the Institute of Medicine.  
   d. Evidence-based design is a component of national, hospital patient satisfaction scores.

10. What design feature did patients in this survey perceive as the most satisfying?
    a. Room size  
    b. Large bathroom  
    c. Reduced noise  
    d. Private room

11. What design feature did patients in this survey perceive as the most dissatisfying?
    a. Remote television control  
    b. Comfort of chairs  
    c. Lighting options  
    d. Clock face design

12. What nursing intervention best reflects application of evidence-based design data?
    a. Open window curtains and blinds whenever possible  
    b. Arrange for semi-private rooms whenever available  
    c. Adjust the television controls for patients  
    d. Control room lighting for patients

Test answers: Mark only one box for your answer to each question. You may photocopy this form.

1. a  2. a  3. a  4. a  5. a  6. a  7. a  8. a  9. a  10. a  11. a  12. a

Name ______________________  Member # __________
Address ______________________
City ______________________  State _____  ZIP ______
Country __________  Phone __________
E-mail ______________________
RN Lic. 1/St __________  RN Lic. 2/St __________
Payment by:  [ ] Visa  [ ] M/C  [ ] AMEX  [ ] Discover  [ ] Check
Card # __________  Expiration Date ______
Signature ______________________

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