

**STATE COMMISSION ON PATIENT SAFETY
ROUND ONE RECOMMENDATIONS
JUNE 8, 2005**

Category D: Implementing Safety Systems in Health Care Organizations

Code 17 (HuDesign) – Human Design: The submitted testimony recommends design and implementation of health care organizational processes and procedures in ways that acknowledge human limitations.

Code 19 (FacDesign) – Facility Design: The submitted testimony recommends design and implementation of physical facilities in ways that support patient safety systems in health care organizations.

Recommendation: D1

An appropriate state level organization should provide leadership in disseminating current knowledge and tools in human factors engineering (HFE) with the goal of incorporating HFE into the design and re-design of health care delivery organizations and care processes. Leadership could be exercised through various means:

- *financial incentives to organizations that design ‘safe’ facilities*
- *grants to educational institutions in Michigan to build the current knowledge base and apply tools in Michigan health care organizations*
- *incorporation of healthcare failure mode and effect analysis (HFMEA) or similar tools into the certificate of need (CON) application process*
- *encourage use of multidisciplinary teams in HFE design efforts*

Recommendation: D1a. *When designing/re-designing facilities and care processes, all healthcare delivery organizations should use human factor engineering techniques of error detection, such as HFMEA, root cause analysis, and usability testing, with greater focus on identifying and correcting defects in system design than adapting human skills to defective processes.*

Recommendation: D1b.

All healthcare delivery organizations should design/re-design their facilities with the patient interaction as the focal point, leading to the examination of major organizational work processes. Critical information for decision-making needs to be brought close to patients, and family involvement facilitated. Healthcare organization facility design should also support team interaction and work among staff members.

Rationale:

The Institute of Medicine (IOM) reports that thousands of medical errors occur in healthcare organizations across the country.¹ Medical errors are often defined as a failure to complete a plan of action as intended or the use of the wrong plan of action. The majority of these errors are considered “near misses” or errors that could have harmed the patient but did not. Other errors result in “adverse

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advents,” which cause injury to the patient beyond the scope of the patient’s underlying disease or condition.²

Human error plays a role in patient injury. The possibility of a patient dying from something that could be prevented is about 3-6 per 1,000 admissions, and adverse events will cause 3-4 deaths per 1,000 admissions.³ Human contributions to the breakdown of well-defended complex systems can be divided into two categories: active failures and latent failures, where the distinction hinges both on who initiated the failures and how long they take to have an adverse effect. Active failures are errors committed by those in direct contact with the human-system interface. Their consequences are apparent almost immediately, or at least within a few hours. Latent failures are the delayed-action consequences of decisions taken in the upper management of the organization or system. They relate to such elements as the design and construction of plant and equipment, organizational structure, planning and scheduling, and training and selection.

Human factors engineering is a field of research and application on the ways in which humans interact with their environment. The field has a rich set of methods and tools that can be used to gain insight into the factors contributing to errors and adverse events. Specific tools such as root cause analysis (RCA) and HFMEA can uncover hidden needs and unexpected interactions, and allow healthcare systems to design facilities and processes to fit human capabilities and limitations.

Facility and Human Design

The environment in which healthcare employees work is believed to affect patient care outcomes and is associated with the structure and process of care.⁴ As a result, as Lundstrom et al. noted, “more attention is being given to designing facilities that are cost-effective, efficient, and functional for staff that also cultivate a caring, healing environment for patients.”⁵

Research by the Picker Institute and the Center for Health Design found that focus group participants wanted acute, ambulatory, or long-term care settings that focused on the well-being of the patient.^{6 7} Participants specified an environment that allowed for a connection to staff and the outside, ensured confidentiality, cared for the family, and provided both safety and security,^{8 9} and where temperature, lighting, and cleanliness that met occupants’ needs were key elements.

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Specific Facility Concerns

Infectious outcomes. Research has shown an association between healthcare facility environments and health outcomes for both patients and employees. One outcome of particular concern is infection, which may be opportunistic, waterborne, or airborne. Facilities can be designed to minimize the risk of infection. The Center for Disease Control (CDC), for example, publishes *Guidelines for Infection Control in Healthcare Personnel*¹⁰, stating that "...controlled ventilation during construction, general and specialty area (e.g., operating) room ventilation, surfaces and water system" are all environmental interventions that can be used to help assist patient and staff safety. Other factors, such as room location and design and the location of air intake and exhaust vents, can decrease airborne infections.^{11 12}

Single bedrooms can reduce infections by limiting exposure to them from other patients and has the added benefit of reducing the noise level patients have to endure. One study found that room isolation, along with HEPA filters, reduced infection rates and mortality in bone marrow transplant patients, and increased patients' one-year survival rate.¹³

Noise levels. Noise affects both patients and staff: "...crowded, noisy, poorly thought out nursing stations and other staff workspaces add to staff stress and increase the risk of medical errors."¹⁴ Loud nursing stations, alarms, overhead pages and other hallway noise adds to the decibels that patients and staff are exposed to. One Midwestern medical center found that during the 7 am shift change, the noise at that bedside was 113 decibels—equivalent to that of a jackhammer.¹⁵ The background noise in the hospital setting is typically between 65-80 decibels. Even these levels are significantly higher than what is recommended by the World Health Organization guidelines for hospital bedrooms.¹⁶

Physical distance. One flaw in the development of healthcare facilities is the physical distance healthcare professionals actually travel during the day. While this includes traveling throughout the entire hospital, the majority of the legwork is done on the unit itself. One healthcare profession that spends a significant amount of time walking is the nurse. A study by Burgio et al. found that almost 29% of nurse staff time is spent merely walking.¹⁷ Other studies have shown that the physical layout of the unit, such as a single or double corridor, can influence the amount of time staff walk in a hospital setting.^{18 19 20 21} Time saved in walking could be translated into more time with patients.

Standardization of design. Standardization is a recurring strategy in human design.²² Its purpose is to decrease human reliance on short-term memory, allowing people to safely use processes or systems that may be unfamiliar to

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them. Standardization of facility design has been investigated in the commercial aviation, information and technology industries and can be applied to healthcare organizations to reduce human error.

Evidence and information on comparable initiatives being carried out in other states:

The idea of a safety-conscious healthcare facility has warranted national attention. The Center for Health Design focuses solely on this aspect of patient and worker safety. Their mission is to "...transform healthcare settings—including hospitals, clinics, physician offices, and nursing homes—into healing environments that contribute to health and improved outcomes through the creative use of evidence-based design."²³

In 2000, the Center initiated their Pebble Project in San Diego Children's Hospital and Health Center. The Pebble Project allows facilities to learn about which design factors make a difference in improving quality of care, based on the experience of other healthcare organizations that already have these designs in place. The project provides access to the financial performance of exemplar facilities to illustrate the importance and cost effectiveness of facility design. Healthcare organizations involved in the Pebble project have shown that facility design improves quality of care, attracts more patients, helps recruit and retain staff, increases community and corporate support, and improves operation efficiency and productivity.²⁴

Improvements at the Karmanos Cancer Institute in Detroit offer one illustration of the effectiveness of the Pebble project. Data collected on two inpatient units that opened in 1999 and 2000 showed:

- Patient satisfaction rose 18%
- Nurse attrition rate fell from 23% to 3.8%
- Lower daily variable costs per case
- Reduced pain medication requirements
- Decrease in medication variances
- 30% reduction in medical errors, a result of the location and increased space in the medication room, the organization of medical supplies, standardized visual cues, and acoustical panels to decrease noise levels
- 6% reduction in patient falls, a result of better visualization of patients, due to attention paid to the angle of doorways, improved lighting, and room layout²⁵

Table 1 illustrates a list of partners who have already adopted the Pebble Project's recommendations for improvements to their healthcare facility design.

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Table 1. Pebble Project Partners

Facility	City, State
Affinity Health System	Appleton, WI
Banner Estrella Medical Center	Phoenix, AZ
Bronson Methodist Hospital	Kalamazoo, MI
Children's Hospital & Health Center	San Diego, CA
Columbia St. Mary's	Milwaukee, WI
Community Mercy Health Partners	Springfield, OH
Edward Hospital & Health Services	Naperville, IL
Froedtert Hospital	Milwaukee, WI
Laguna Honda Hospital & Rehabilitation Center	San Francisco, CA
Lake Hospital System	Lake County, OH
M.D. Anderson Cancer Center	Houston, TX
OhioHealth Corporation	Dublin, OH
Palomar Pomerado Health (PPH)	Escondido, CA
Parrish Medical Center	Titusville, FL
PeaceHealth Oregon Region	Eugene, OR
Provena Saint Joseph Medical Center	Joliet, Illinois
Saint Alphonsus Regional Medical Center	Boise, ID
Scott & White Memorial Hospital	Temple, TX
Shawnee Mission Medical Center	Shawnee Mission, KS
Sitrin Health Care Center	New Hartford, NY
SSM Health Care	St. Louis, MO
St. Benedicts Family Medical Center	Jerome, Idaho
St. Elizabeth's Hospital	Appleton, WI
St. Joseph's Community Hospital	West Bend, WI
Village Care of New York	New York, NY
Weill Cornell Physician Organization	New York, NY
Yavapai Regional Medical Center	Phoenix, AZ

Alumni Partners

Barbara Ann Karmanos Cancer Institute	Detroit, MI
Methodist Hospital - Clarian Health Partners	Indianapolis, IN

The National Institute for Occupation Safety and Health (NIOSH) is particularly concerned with improving the healthcare facility environment to ensure the safety of staff as well as patients, and has made a number of recommendations to prevent injury in healthcare organizations.

Recommendations for improved facility design have also been adopted through the use of JACHO sentinel events reporting and input from the VA Center for Patient Safety.²⁶ These recommendations were used by St. Joseph's in Wisconsin to develop a more safety conscious facility. Table 2 illustrates the principles on which this safety culture was built. Other resources used by St. Joseph were the "Serious Reportable Events in Healthcare," issued by the National Quality Forum.

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Table 2. Facility safety design principles²⁷

<p>Design around latent conditions:</p> <ul style="list-style-type: none">• Noise reduction• Scalability, adaptability, flexibility• Visibility of patients to staff• Patients involved with care• Standardization• Automate where possible• Minimize fatigue• Immediate accessibility of information, close to the point of service
<p>Design around precarious events/active failures:</p> <ul style="list-style-type: none">• Operative/post-op complications/infections• Events relating to medication errors• Deaths of patients in restraints• Inpatient suicides• Transfusion related events• Correct tube-correct connector-correct hole• Patient falls• Deaths related to surgery at wrong site• MRI hazards

In a 2004 report to the Center for Health Systems and Design, Ulrich and Zimring, leaders in facility design, outlined feasible solutions to design problems based on over 600 research studies.²⁸ Their report concluded:

- Single rooms should be used in almost all situations. They reduce nosocomial infections and room transfers, decrease noise, improve confidentiality and privacy for patients as well as communication between staff and patients, and increase patient satisfaction. When patients must share a room, their risk of nosocomial infections increases as does the risk of receiving the wrong medication.
- New hospitals need to be quieter. This will reduce stress and increase hours that patients can sleep. Quieter hospitals can be achieved by installing sound-absorbing ceilings and using noiseless paging systems.

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- Healthcare facilities should improve ventilation systems, especially during construction, to reduce infections.
- Lighting should be improved to reduce medication errors.
- Physical design of the units and nursing stations should be redesigned to reduce staff walking and increase patient care time.

Barriers:

- The cost of remodeling, making improvements, or building a completely new facility would be major concerns to many healthcare organizations. Derek Parker, a board member for the Center for Health Design, calculated that a 300-bed hospital with single rooms, decentralized nursing stations, and other evidence-based design components would add \$12 to \$240 million to the building cost of a healthcare facility.²⁹ This is essentially a 5% increase from typical building costs. This barrier, however, is offset by expected returns on investment. Parker's calculations showed that sums could be recuperated within the first year through improved staff performance, reduced expenses from patient falls (at a cost of \$10,000 per patient), patient transfers (\$500-700 per patient), infections and medical errors. In general, facilities designed around patient safety are likely to show a return on investment in two specific areas: efficiencies through standardization and cost savings from reductions in near misses, adverse events, errors, and lengths of stay.³⁰

Pros:

- As discussed above, there is evidence that significant gains can be made in a number of areas of patient safety when attention is paid to facility and human design. Improvements include fewer medication errors and patient falls, greater patient confidentiality and privacy, lower lengths of stay, and overall increases in patient satisfaction and quality of care.

Implementation Steps: TBD

Cost: TBD, depending on what types of facility changes or designs are required.

Implementation Target Date: TBD, depends on recommendation(s) supported.

Grade: TBD

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Endnotes

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²⁶ Reiling, op cit.

²⁷ Reiling, op cit, p. 4.

²⁸ Ulrich and Zimring, op cit., pp 26-27.

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