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Designing a Safe Hospital

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It is very seldom that an opportunity emerges to build a new hospital; indeed most hospitals are in a continuous cycle of remodeling and expanding their existing facilities to adapt to changing demands. St. Joseph's Community Hospital of West Bend, Wisconsin has decided to relocate and build a new hospital rather than redesign an existing facility. Hospital leadership is going about this effort in an innovative way. In planning for its new facility, it approached the hospital design process with a blank sheet of paper, an appreciation of the evidence that there is ample opportunity to improve hospital patient safety, and the belief that improving hospital facility design will not only increase patient safety directly, but also will indirectly promote a safety-oriented organizational culture. With millions of dollars expended annually on healthcare construction, there is a need to develop a set of safety driven design principles for all healthcare organizations, including new facilities, remodeling, and additions.

St. Joseph's Community Hospital of West Bend

St. Joseph's Community Hospital of West Bend is an independent, nonprofit, acute, and subacute care hospital, with over 6,100 admissions per year and 206 staff physicians. Its affiliate, West Bend Clinic, is a multi-specialty group of 46 physicians serving patients in three locations. St. Joseph's Hospital, which first opened its doors in 1930 as a Sisters of the Divine Savior Hospital, built additions to the facility in the 1940s, 1970s, and 1990s. Hospital ownership was subsequently transferred from the Sisters of the Divine Savior to a 501c3 community organization in 1971. In November 2000, hospital leadership recognized that its facility was inadequate for the practice of 21st century medicine and directed development of plans for a new hospital. The decision to build the facility at a new location was determined in December 2001, with the location of the new hospital selected in May 2002.

"We shape our buildings and afterwards our buildings shape us."

WINSTON CHURCHILL, MAY 10, 1941

Charting the Course for Patient Safety—A Learning Lab

With a history of commitment to patient safety initiatives and activities in process improvement, and inspired by the 1999 Institute of Medicine Report, *To Err is Human: Building a Safer Health System*, internal discussion at St. Joseph's focused on how design of the new facility could affect patient safety. John Reiling, President and CEO of St. Joseph's, contacted leaders in patient safety, quality improvement, and human factors to seek their advice. He concluded that there was an opportunity to learn collectively about how a facility could be designed to improve patient safety. To facilitate this learning, a conference was convened on April 18-19, 2002. Two keynote speakers set the stage for the participant workshops that followed. The first, John Wreathall, M.Sc., addressed the topic of designing facilities using lessons learned from his work in the nuclear and transportation industries. The second, Donald Holmquest, M.D., Ph.D., J.D., drew on his experience as a physician, a scientist, and an astronaut with NASA, to describe how both hospitals and spacecraft have many hazards emerging from their complex and repetitive processes that produce comparable design demands.

"In healthcare, compared to other industries, there is a particular challenge in treating human error because hospitals engage in an enormous range of activities, deal with vulnerable rather than intact people, and have many uncertainties and hazards that are intrinsic to medicine and delivery of health care."

JOHN WREATHALL, M.Sc.

A Model of Safety

A *Facilities Design and Safety* model, developed from work in other industries but applicable to designing for hospital patient safety, formed the core of the presentations. The model suggests that meltdowns can occur on the part of individuals near in time to the "moment of failure," but individual job tasks (e.g., injecting toxic medication) and work environment (e.g., hand written order entry systems) can influence the likelihood of unsafe actions. At the foundation, organizational factors shape the conditions for success or failure.

The organization shapes a culture of patient safety in several ways. Leadership, communication, discipline, "just" versus "blaming" reporting systems, analysis of near misses, standardization, and assessment of culpability all are keys to supporting the right kind of culture - a learning organization committed to patient safety. Facility design can set the framework for addressing and changing cultural values.

"I am convinced that designing a building around safety will create a culture of safety."

JOHN REILING, PRESIDENT AND CEO ST. JOSEPH'S COMMUNITY HOSPITAL AND *Synergy*Health

Physical Systems and Design Processes

Failure Modes and Effects Analysis is a design process tool used in other industries, as well as by some healthcare organizations such as the Joint Commission on Accreditation of Health Care Organizations. The goal of FMEA is to anticipate, identify and avoid failures in the operation of a new system while the system is still on the drawing board. The FMEA consists of a set of guidelines for identifying, prioritizing, and correcting potential failure modes early in the design cycle where it is easier to take actions to overcome these issues. In order to be an effective design process, however, FMEA requires team-based problem solving and includes all individuals with relevant knowledge.

The keynote speakers underscored that safe hospitals can be built by using a design process that supports the anticipation, identification and avoidance of failures; by designing against the latent conditions compromising physical and organizational defenses; and, by creating an organizational culture of safety. The physical environment of a hospital must support a treatment environment that facilitates the use of systematic processes, consistently applied, and directed toward safety.

Workgroup Sessions

Subsequent to presentations by keynote speakers, participants in workshop sessions were led through a structured process designed to develop recommendations that St. Joseph's Hospital could apply in designing a safe hospital. These patient safety experts included 28 local and national leaders in systems-engineering, healthcare administration, health services research, human behavior research, hospital quality improvement and accreditation, hospital architecture, medical education, pharmacy, nursing, and medicine. In addition, over 65 individuals from St. Joseph's Community Hospital and other local hospitals were invited to observe the workgroups address this challenge. To structure the brainstorming process, workshop leaders identified the major causal categories of patient harm in hospitals. Then, participants in each group developed a set of recommendations for facility design around four issues: 1) design principles for creating a safe facility; 2) work process and systems; 3) technology and equipment; and 4) physical environment. At the end of the workgroup sessions, additional input was gathered by means of written suggestions from the observers at each group.

FIGURE 1 PARTICIPANTS IDENTIFY 10 FACILITY DESIGN PRINCIPLES

Failure Analysis Should Be Ongoing

Noting that the facility design process was not linear, but iterative, participants first recommended FMEA (presented earlier by the keynote speakers) as a basic design tool for patient safety. They proposed that FMEA be completed at every design stage and that the design process be data driven, not based on traditional design "knowledge."

Stakeholder Input Is Critical

A second principle was that all stakeholders (including patients, families, maintenance staff, vendors and professionals) should be involved from the beginning and at all design phases. The design process should be open to multiple views and every idea considered. Participants believed it was important to seek and use data beyond the institutional experience. Where data are absent, it was recommended that staff draw on testing and simulations with end users. Simulation tapes, as well as design plans, should be sent to outside reviewers for comment. The institution itself should have a designated area with prototypes, computers, and software where individuals can review progress, experiment with designs, and offer ideas.

Accountable Leadership Is Needed To Drive The Process

A third principle was to designate a leader to be accountable for implementing the new design process. This individual would facilitate the exchange of ideas, provide immediate feedback to teams, set priorities, and lead a cross-functional decision making group. Additionally, the leader would be charged with systematically accumulating and documenting what various parts of the organization know and identifying regulatory barriers that might inhibit accomplishing the ideal design.

Design Should Focus On Organizational Processes

Currently, facilities are designed around "departments." In contrast, participants recommended that they be designed around major organizational processes, for example, surgery or medication administration. There needs to be early definition, observation and documentation of these core processes to understand current reality, before they can be systematically addressed in the design process. To identify existing and potential hazards, participants believed that mock-ups, simulations, and workflow analyses should begin on the first day of

Improving the Design Process

Each workgroup initially reviewed the *traditional process for facility design*. The task was to reconsider this process and to generate principles and guidelines for a more *contemporary facility development process* driven by the commitment to patient safety. One of the products of this brainstorming was a checklist based on recommended design principles. The traditional hospital design process requires that architects be given program objectives, room requirements, and any constraints such as locating next to other departments. Typically, no issues about patient safety are raised, essentially creating an environment with great potential to repeat latent errors. Architects then create space blocks next to each other, draft in the details, and convert to construction blueprints. Good architects "know" how rooms should be designed. Their blueprints fundamentally define how individuals and equipment in hospitals will function, within an allotted space, to facilitate their current work.

The challenge to participants was to recommend how this traditional process should be changed in ways that could result in the design of a safer facility. Ten design principles emerged from the work groups *(Figure 1)*.

Learning from Precarious Events

In a second break-out session, participants made additional facility design recommendations by focusing on 10 specific precarious hospital events and their root causes. These events had been identified earlier through a review of the sentinel events databases of the Joint Commission on Accreditation of Healthcare Organizations and the Veterans Administration National Center for Patient Safety, and included: operative/post-op complications; in-patient suicides; correct tube —correct connector—correct hole placement events; medication error related events; wrong site surgery events; oxygen cylinder hazard; deaths of patients in restraints; transfusion related events; patient falls; and MRI hazards. Discussion of these events resulted in a reaffirming of the set of recommendations for facility design that evolved in the first session.

Prioritizing

In the last step of the process, all 28 participants engaged in a review and reporting process where information from the workgroups was condensed in a final set of facility design recommendations. Through a round of "multivoting," each participant voted for 10 of his or her preferred

design and continue throughout the process.

Design Should Reflect An Understanding Of Human Factors

The fifth principle to emerge was the need to design with an understanding of human factors. Participants recommended designing with the patient interaction as the focal point. By acting on this principle, the new design process will provide opportunities to examine and change major organizational work processes, such as the admission and discharge of patients. Facilitating family involvement in patient care and teaching also has design implications. Movement of patients within the hospital was identified as a common threat to patient safety in current work processes. When possible, care needs to be brought to the patient rather than the patient to care. The design process should reflect this belief. Human factors also must be considered on the staff side. Failures attributed to individuals often result not from steps in the process, but from poor communication or coordination between the steps. For instance, many things go wrong at the change of shifts, within and across disciplines. In the past, team space for interaction has been a soft value, frequently sacrificed for what appears to be more immediate facility needs. Facility designs must promote the concept of team and create an environment that supports team interaction and work. Additionally, design must adjust for failures from memory, fatigue and ergonomics that result from repetitive and complex work processes.

Design Should Occur With Vulnerable Populations In Mind

Designing around common needs of patient groups in a full service hospital may require that rooms look and function differently yet share similar processes and technology. When making design choices, the solution should work for the most vulnerable patient.

Design Should Be Flexible Enough To Accommodate Change

Flexibility, scalability, and accessibility were identified as critical and interrelated design principles. Forecasting the future is risky, and the facility must have the capability to easily accommodate, expand, and adjust to changes in technology and work processes. Computer-based advances such as electronic medical records, bar coding, and computer-based order entry are now necessary infrastructure. Future technical

recommendations for facility design. Final recommendations were prioritized by counting the number of "votes" for each, *(Figure 3)*.

Next Steps

As the conference drew to a close, John Reiling spoke of the next steps in the St. Joseph's Community Hospital facility design process. For immediate feedback, a summary of the learning lab, the top recommendations and condensed videotape have been made available to the participants and others. As the facility design process progresses, a national follow-up conference is scheduled for June 27, 2002 to allow participants to give feedback to the design team of St. Joseph's Community Hospital on their implementation of the recommendations. Additional conferencing with participants is expected to continue through the facility design process, at the end of each design stage. It is the intent of the design team to incorporate the top ten recommendations from the participant panel, as well as many of the other suggestions that were made at the learning lab. For example, in the first week of June 2002 the hospital is hosting a technology fair to begin implementing one of the recommendations—planning for technology and equipment on day one of the design process. And, all will be invited to the ribbon cutting ceremony targeted for May 5, 2005.

FIGURE 2 FACILITY DESIGN PRINCIPLES

Use Failure Modes and Effects Analysis (FMEA) on current facility and at every design stage. Design process should be data driven.
Engage a wide representation of stakeholders in the design process.
Create an organizational leadership structure to support the design process.
Design around major organizational processes. Begin mock-ups and equipment planning Day 1.
Consider the human factors and environmental effects on staff as well as patients and families.
Design around the vulnerable populations.
Design for flexibility, scalability, and accessibility to adapt to changes in technology and work processes.
Design for maximum standardization.
Provide accessible information systems at the point of service.
Address known hazards to patient safety in the physical environment.

FIGURE 3 RANKING OF PARTICIPANT RECOMMENDATIONS

1. Design FMEA at each design stage.
2. Standardize location of equipment, supplies, room layout, and care processes.
3. Involve patient/families in the design process.
4. Use an established checklist for current/future design.
5. Bring critical information for decision-making close to the patient.
6. Reduce noise.
7. Use adaptive systems that will allow function in the future.
8. Articulate a set of principles by which everything is measured.
9. Begin equipment planning on Day 1.
10. Begin mock-ups on Day 1.

advances (e.g., "filmless" radiology) inevitably will change work processes. Facility design requires the flexibility to eliminate unsafe conditions from new technology and processes with respect to, for instance, ceiling height, wiring, tubing, lighting, door and hall width, and building materials.

Design Should Be Standardized Where Possible

Medical equipment, technology, space, room orientation, and procedures should be standardized to the extent possible. For example, medication systems should have as many processes as possible controlled by technology, including computer-based order entry, robotics, pneumatic delivery system, and bar coding. At the same time, patient or family medication administration should be facilitated. Equipment planning to support other core processes also should start early in the design process and be standardized as much as possible. Not only should equipment from vendors be reviewed for safety requirements, but planners should work with vendors to promote standardization across all similar products of fittings, hook-ups, tubes, labeling, and review process for equipment malfunction. To assist workflow, orientation of the critical care rooms (e.g., emergency, intensive care, operating) as well as materials handling should be standardized.

Design Should Facilitate Immediate Access To Information

Critical information that is used for decision-making should be close to the patient with easy access at the point of service. Additionally, the design must accommodate an integrated information system to manage care processes from any point in the hospital.

Design Should Address Known Threats To Patient Safety

Finally, there are a number of known threats to patient and staff safety in the hospital physical environment, both in patient and operations areas that must be corrected in the design process. These include: poor visibility of the patient for monitoring while providing privacy, inadequate lighting, excess noise, inadequate patient activated call systems, bathrooms with risks for patient falls, outdated security, open access to critical care areas, elevators with insufficient space for patient transport, insufficient handwashing sinks, poor air filtration, inadequate storage for supplies, unsafe patient restraints, lack of visual cues to orient patients, and poor ergonomics.

Design principles are summarized in Figure 2.

St. Joseph's Community Hospital of West Bend
a member of SynergyHealth

hospital 1930

present facility

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