

Creating Safer and More Efficient Pharmacies through Evidence-Based Design

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A trip to the pharmacy can be routine. A visit to the doctor results in a prescription and the patient fills the prescription at an outpatient, ambulatory or local retail pharmacy. To many, the extent of the interaction is a drop-off, a pick-up, and possibly counseling. However, what they don't see are the complex interactions required to deliver the prescription promptly and correctly.

National statistics indicate that more than 1.5 million preventable medication related adverse events occur each year in the US, with costs of more than \$177 billion annually for associated care (Ernst & Grizzle, 2001; IOM et al., 2007). Several studies document error rates at Outpatient and Ambulatory Pharmacies between 3.23 percent and 12.5 percent (Buchanan, K. N Barker, Gibson, Jiang, & Pearson, 1991; E. A Flynn et al., 1999; Guernsey et al., 1983; Kistner, Keith,

Sergeant, & Hokanson, 1994). Opportunities for errors are often a result of latent conditions, which are the inevitable “resident pathogens” within the system. They arise from decisions made by designers, builders, procedure writers, and top level management (Reason, 2000). In pharmacies, latent conditions can include noise, lighting, interruptions and distractions, and volume of prescriptions filled per hour. Latent errors can often be reduced through environmental design interventions.

FIGURE 1: THE PEBBLE PROJECT PARTNERS



A recent article summarized observational research conducted in more than a dozen pharmacies. The research team conducted extensive secondary research, interviewed experts and observed where pharmacy services are delivered in both inpatient and outpatient pharmacies within hospitals, community pharmacies belonging to retail chains, and independent, pharmacist-owned pharmacies. The authors found that four main issues affected all sites: error, efficiency, attraction and retention, and compliance to rules and regulations (Kelly & Redman, 2008).

EVIDENCE-BASED DESIGN

The notion of using design to affect outcomes is not necessarily new, but a process of using the best available research to inform decision making in facility design is still gaining traction. This growing trend is called evidence-based design (EBD), which is defined as the process of basing decisions about the built environment on credible research to achieve the best possible outcomes (The Center for Health Design, 2008). The EBD process allows designers, end-users, healthcare providers, and researchers to collaborate, review and

evaluate the available literature and develop design strategies with hypothesized outcomes. A 2008 literature review found a growing number of studies (in excess of 1,000) that establish a relationship between the physical design of hospital and key outcomes (Ulrich et al., 2008).

In healthcare facility design, EBD can include patient safety (falls, nosocomial infection, and medication errors), worker safety and effectiveness (injuries, workflow processes and satisfaction), environmental safety (reducing energy use, improving ambient noise, air quality and lighting), and quality of

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-The Center for Health Design, 2008

THE PEBBLE PROJECT AND THE CENTER FOR HEALTH DESIGN

Through initiatives related to research, education and advocacy, The Center for Health Design has been developing awareness and providing support for the EBD process since its inception in 1993. One of the most well-known research initiatives of The Center is the Pebble Project. With more than 70 active and alumni partners, the Pebble Project provides support to forward-thinking organizations to advance research in healthcare facilities, whether new construction, addition or renovations. Formed with the idea that a pebble dropped in a pond creates a ripple, the research developed through the Pebble Project is creating a ripple effect in the industry through changes in best practices, guidelines, and codes.

THE PEBBLE PROJECT IN WISCONSIN

While Pebble Projects are located throughout North America, there are five Pebble Partners in Wisconsin:

- ProHealth Care, Waukesha Memorial Hospital, Waukesha
- Affinity Health System, St. Elizabeth Hospital, Appleton
- Froedtert Hospital, Cancer Center Pavilion, Milwaukee
- St. Joseph's Community Hospital, West Bend (alumni partner)
- Columbia St. Mary's Hospital, Milwaukee (alumni partner)

care (improved satisfaction, reduced length of stay). There will never be evidence to support all of the decisions required during the design and construction of healthcare facilities and, for many Pebble Partners, the decision regarding where to focus research efforts is a difficult one. Pebble Partners determine what new and unique design innovations within their building projects they would like to test for performance or effectiveness. Their research project might provide a way of assessing whether the building project goals have been met (i.e. decrease medication errors or increase patient satisfaction) or determine if any new or controversial innovations have support for implementation. Additionally, evidence-based design research affords the opportunity to study something that has not been adequately addressed in best practice or well-represented in published literature.

Several Pebble Partners have considered the impact of pharmacy design on errors and efficiency. Key questions have explored whether new medication distribution systems are more effective in reducing medication errors and distribution time and how the floor plan and spatial features of the new facility impact the number of distractions during medication distribution.

DESIGN EFFECTS IN PHARMACIES

Reducing errors, improving patient and staff satisfaction, modifying workflow processes for efficiency, and reducing wait time are just some of the priorities many organizations consider



to affect outcomes. The EBD process can be applied to specific areas within healthcare, such as pharmacies, to address these concerns. Papers specific to pharmacies can be classified in two broad categories – studies investigating errors and causes (i.e. distraction, illumination) and studies related to patient satisfaction (i.e. wait times, expectations). Published sources of information include:

Errors

- Interruptions and Distractions (Barker, Pearson, Helper, Smith, & Pappas, 1984; Bepko, Moore, & Coleman, 2009; Borel & Rascati, 1995; Kuiper, McCreddie, Mitchell, & Stevenson, 2007)
- Automation (Barker et al., 1984; Bepko et al., 2009; Borel & Rascati, 1995; Kuiper et al., 2007)
- Illumination (Buchanan et al., 1991; Flynn, Dorris, Holman, Carnahan, & Barker, 2002; Grasha, 2002)
- Noise (Flynn et al., 1996; Flynn et al., 2002; Grasha, 2002)

Patient Satisfaction

- Initiatives to improve customer satisfaction and reduce wait time (Afolabi & Erhun, 2003; Akalin-Baskaya & Yildirim, 2007; Arthur, 2005; Briesacher & Corey, 1997; Cheng, 2004; Johnson, Parker, McCombs, & Cody, 1998; Kucukarslan & Schommer, 2002; Lang & Fullerton, 1993; Larson, Rovers, & MacKeigan 2002; Nosek & Wilson, 2001; Pierce, Rogers, Sharp, & Musulin, 1990; Pinto, Sahloff, & Ramasamy, 2009; Slowiak, Huitema, & Dickinson, 2008)

DESIGN GUIDELINES FOR PHARMACIES

Based upon the amount of available research and expert opinion, the United States Pharmacopeia (USP) recently proposed a safe environment chapter including recommendations for illumination, interruptions and distractions, sounds and noise, the physical design and organization of the workspace, and medication safety zones (USP The United States Pharmacopeial Convention), 2008). This draws on evidence, not only from the field of healthcare, but other industries such as environmental psychology, human factors engineering, and lean thinking.

A summary of the proposed chapter listed the following research findings (Cohen & Smetzer, 2009):

FIGURE 2: COMPONENTS OF SAFE PHARMACY DESIGN SUMMARIZED FROM USP, 2008



- **Illumination:** Improper lighting can be a contributing factor in medication errors. Proper lighting improves accuracy and efficiency of medication dispensing. Lighting levels must be increased for workers over the age of 45 and when fatigue increases near the end of a shift. The design recommendations include lighting type, positioning, and illumination levels.
- **Interruptions and Distractions:** Distractions account for 45 percent of medication errors. The suggested solutions include areas with minimized distractions, the use of visual cues (i.e. safety vests) and staff education and awareness.
- **Sounds and Noise:** Hospitals are noisy environments, and numerous studies document noise levels in excess of the World Health Organization Standards. Of 58 studies reviewed by USP, 29 showed that noise impaired performance. Design interventions to consider are quiet areas

for staff during critical medication tasks, the use of sound absorptive materials, and periodic audits of noise levels.

- **Physical Design and Organization:** Poor ergonomics can influence the ability to use information and perform tasks. Counter and shelf heights affect visibility and clutter has been shown to impact dispensing errors when items become difficult to differentiate. The design of the space can also influence lighting, noise, and interruptions as discussed above. Recommendations include specific spacing between distinct drugs, appropriate heights for work counters, and the use of adjustable fixtures.
- **Medication Safety Zones:** Defined as any critical area where medications are prescribed, transcribed, prepared, and administered, medication safety zones can include counters, medication carts, pharmacies, the patient bedside, and

even homes where medications are administered. In this area, the field of human factors provides a wealth of information. As a result, USP suggests designing areas on the cockpit principle (readily available information, user-friendly, and all together) to support fact finding. Areas should be organized such that important components are in convenient locations, frequently used items are located where they can easily be found without workarounds, items related functionally are grouped together, and items are placed in an order that supports the sequence necessary to support the task. Standardization is also emphasized, along with the use of design constraints and forcing functions for high-alert medications.

PATIENT SAFETY AND RISK ASSESSMENT

The newly released 2010 guidelines of the Design and Construction of Healthcare Facilities proposed the use of a Patient Safety Risk Assessment (PSRA) as an appendix item. The PSRA has been defined as “an assessment of the potential risks to patients inherent in each space and building component that is to be part of the project. For each space or component PSRA should identify the specific hazards, the likelihood of their occurrence based on historical data, and the degree of potential harm to patients from the hazards.” (The Facility Guidelines Institute, 2010) Pharmacies seem like a logical area for this process.

In addition, the guidelines state, “The PSRA should be conducted by an interdisciplinary panel appointed by the owner that is made up of representatives from clinical departments that are part of the project or could be affected by the project, safety specialist(s), medical staff, infection preventionists, architects, engineers, and other appropriate individuals.”

The EBD process establishes an interdisciplinary group and often requires groups that do not work directly together to develop the most appropriate solutions. Such participation allows the entire team to evaluate the systems model – considering the upstream and downstream effects of new designs and processes. This is especially true in pharmacies that touch so many areas of the patient and staff experience. Using an EBD process, it seems the PSRA could be effectively integrated into the design process for healthcare facility pharmacies.

TRANSLATING DESIGN INTO REALITY

Froedtert Hospital’s Cancer Center in Milwaukee is a Pebble Project making design and operational changes to the pharmacy – both the Infusion Pharmacy and the onsite retail pharmacy. Froedtert Hospital’s Cancer Center Pavilion, which opened in 2008, was designed to create a clinical and support “hub” around each patient. Centralization is a key feature of the Cancer Pavilion with all support services, treatment areas, and resource centers including a dedicated pharmacy for cancer patients within the new space. Dedicating an on-site retail pharmacy within the Cancer Pavilion has proven effective in meeting several of Froedtert’s pre-determined design goals such as ‘convenient and accessible’, ‘consideration of impairments’, ‘caring of family and their needs’ and ‘promote confidentiality and privacy’.

At the time of initial planning, there was a large space dedicated to the infusion room pharmacy. It had a centralized location very near the infusion beds/chairs and was built to comply with USP 797 standards. The retail pharmacy was located in close proximity to the other “retail” services and an important component of creating a retail atmosphere. The design aesthetic was based on an old-fashioned pharmacy with antique décor. Patients walk up to the counter and speak directly with a pharmacist. It also looks out to lush green landscapes and a pond, creating a calming effect.

Lessons learned included the following:

Infusion

- Carefully review USP 797 regulations prior to beginning any work and review requirements with design team to ensure full understanding
- Plan space to allow for future growth in infusion volume
- Position the pharmacy strategically to the infusion suites and evaluate logistical issues surrounding drug delivery (i.e. tubes, dumbwaiter, delivery personnel, etc)

Retail

- Ensure adequate counter space reducing the need for further construction after growth
- Locate retail pharmacies in a high traffic area—evaluate anticipated patient flows
- Plan for adequate waiting space

Located in San Francisco, California,

Laguna Honda Hospital (another Pebble Project) designed their pharmacy with the goal of improving several outcomes: reducing staff distractions and interruptions, improving operational workflow and efficiency, and increasing staff morale, recruitment and retention. The facility is currently under construction, and the design features of the new space to achieve their hypothesized outcomes include:

- Computer order entry/verification area; and sterile compounding areas
- Order entry, order review, medication filling areas
- Centralized drug storage area
- Designated area for non-sterile compounding
- Designated room for private patient counseling
- Ergonomic environment (chairs, workstations, counters, mats, etc)
- Natural lighting

Another Pebble Project just beginning the programming and design for their pharmacy is the VA Medical Center East Orange New Jersey Health Care System (VANJHCS) East Orange Campus. The East Orange Campus division is a general medicine, surgical and psychiatry level 1b facility located in the northeast section of the state immediately adjacent to the City of Newark. VANJHCS is affiliated with the University of Medicine and Dentistry of New Jersey – New Jersey Medical School and is a Planetree Affiliate Member. They are currently striving to achieve Patient-Centered Hospital Designation in acute care and continuing care. (The Patient-Centered Hospital Designation Program is recognized by the Joint Commission and created by Planetree to recognize hospitals around the world that have embraced and implemented patient-centered care in a comprehensive manner.) Having received an internal VA Innovation Grant for the project, the team will focus on redesign to address the extremely low patient satisfaction scores for this area. Because pharmacies are part of nearly every Veteran’s experience, the changes will become a demonstration project that can be used to improve pharmacies in other VA locations. Using an evidence-based design process, the VA has established preliminary design goals for the project that include:

- Improved privacy, an improved waiting experience, and reduced wait times
- Redesign of the counseling and dispensing areas



- A proactive approach to availability of educational resources
- Improved physical comfort and pain management through the selection of appropriate furnishings and positive distractions
- An architectural layout conducive to health and healing (through the use of Planetree and evidence-based design principles that support improved patient outcomes)
- An improved work environment that reduces noise, distractions, stress, and fatigue

CONCLUSION

Design has the ability to influence outcomes and, while there has been a rapid growth in the availability of credible research in healthcare facility design, the field of evidence-based design is still growing in many areas. The complex nature of pharmacy design—considering workflow, staff work environments and the patient experience—can be advanced through the collaborative process of evidence-based design. In his paper, *Human Error: Models and Management*, James Reason states, “We cannot change the human condition but we can change the conditions under which humans work” (Reason, 2000). Evidence-based design offers the opportunity to draw upon the latest credible research to positively impact safety, the work environment, and the patient experience, not just in hospitals and ambulatory care clinics, but in pharmacies, as well. ●

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