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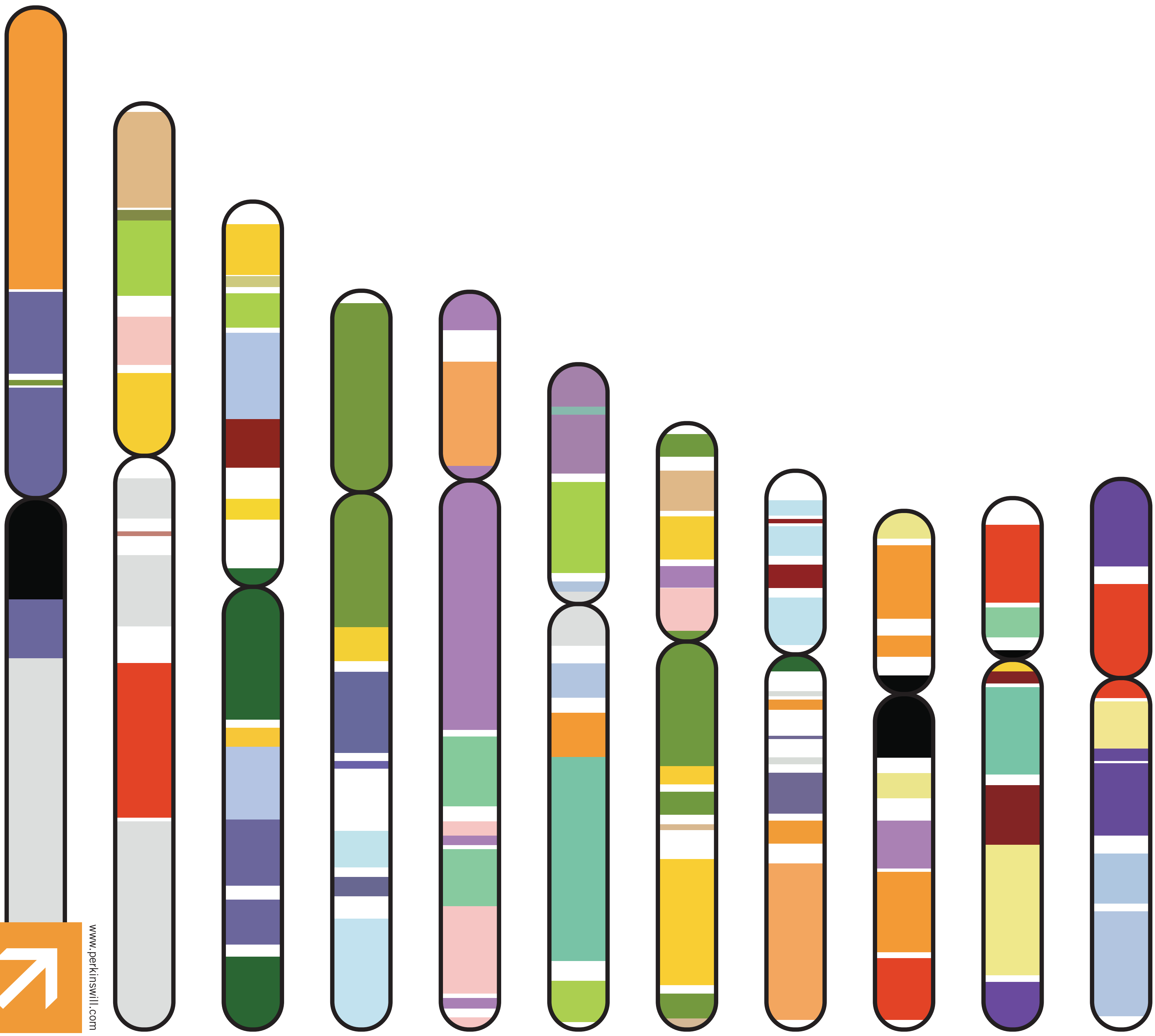
Research Journal

2012 / VOL 04.02



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PERKINS+WILL **RESEARCH JOURNAL** 2012 / VOL 04.02

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Perkins+Will is an interdisciplinary design practice offering services in the areas of
Architecture, Interior Design, Branded Environments, Planning + Strategies and Urban Design.

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JOURNAL OVERVIEW

The Perkins+Will Research Journal documents research relating to architectural and design practice. Architectural design requires immense amounts of information for inspiration, creation and construction of buildings. Considerations for sustainability, innovation and high-performance designs lead the way of our practice where research is an integral part of the process. The themes included in this journal illustrate types of projects and inquiries undertaken at Perkins+Will and capture research questions, methodologies and results of these inquiries.

The Perkins+Will Research Journal is a peer-reviewed research journal dedicated to documenting and presenting practice-related research associated with buildings and their environments. Original research articles, case studies and guidelines have been incorporated into this publication. The unique aspect of this journal is that it conveys practice-oriented research aimed at supporting our teams.

This is the eighth issue of the Perkins+Will Research Journal. We welcome contributions for future issues.

RESEARCH AT PERKINS+WILL

Research is systematic investigation into existing knowledge in order to discover or revise facts or add to knowledge about a certain topic. In architectural design, we take an existing condition and improve upon it with our design solutions. During the design process we constantly gather and evaluate information from different sources and apply it in novel ways to solve our design problems, thus creating new information and knowledge.

An important part of the research process is documentation and communication. We are sharing combined efforts and findings of Perkins+Will researchers and project teams within this journal.

Perkins+Will engages in the following areas of research:

- Market-sector related research
- Sustainable design
- Strategies for operational efficiency
- Advanced building technology and performance
- Design process benchmarking
- Carbon and energy analysis
- Organizational behavior

EDITORIAL

This issue of Perkins+Will Research Journal includes five articles that focus on different research topics, such as process modeling used to inform size of waiting spaces in outpatient clinics; methods used to distract patients of different ages in pediatric clinics and relationships to design attributes; risks and liability associated with the design of sustainable buildings; simulations and use of lean design principles for space planning in emergency departments; and methods for improving patients' waiting times in healthcare facilities.

"Process Modeling Informing the Size of Waiting Spaces" discusses the modeling used to determine the appropriate size of waiting spaces for outpatient clinics. The modeling process considered operating schedules and patient volumes, length of time that patients spend in different spaces during medical visits, and probabilities of other visitors accompanying patients. The simulation model was used to compute the number of waiting spaces based on these variables.

"Positive Distraction and Age Differences: Design Implications for Pediatric Patients" reviews a study that was conducted as part of the post-occupancy evaluation for a pediatric clinic. The objective of the study was to investigate the techniques used by medical staff to distract pediatric patients during medical visits, and how design characteristics support these techniques. The study considered different age groups, and was based on a survey that was administered to the medical staff.

"Architect's Professional Liability Risks in the Realm of Green Buildings" is a literature review that addresses professional liability risks associated with the design of green buildings, and methods for managing those risks. The article discusses how architects' duties are affected by green building and certification standards, potential liability risks, and how these possible risks can be mitigated.

"Simulation Modeling as a Method for Determining Facility Size of an Emergency Department Using Lean Design Principles" discusses the process used to determine the appropriate size of an existing emergency department using simulation modeling. The model considered patient flow through the emergency department and different acuity levels, and current and projected numbers of patients. Four different scenarios were simulated, calculating the average patients' waiting time. Conclusions state that the simulations and modeling are useful in testing facility plans and programs prior to the design and construction of new or renovated facilities, and can be used in the lean design process to understand specific space requirements during programming stage.

"The Impact of an Operational Process on Space: Improving the Efficiency of Patient Wait Times" presents a study that was conducted to understand the relationships between operational practices and space requirements for an emergency department in a large hospital. The research methods included an observational study, data collection, and operational modeling in order to determine the space requirements.

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01.
PROCESS MODELING INFORMING THE SIZE OF WAITING SPACES

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ABSTRACT
This article outlines the use of process modeling at Perkins+Will to determine the appropriate size of waiting spaces and number of seats for outpatient clinics in a medical office building in the Southeast. Opening in 2013, the building represents an addition of more than 200,000 square feet to the campus. Inputs to the process model included provider schedules, length of time for each process during a patient's visit, and probabilities of the number of people accompanying each patient to a visit. These inputs were programmed into a simulation model that computed the number of seats needed in the waiting space throughout the day. Then, the provider schedules were modified to stagger each provider's start time. This modification resulted in a significant reduction in the number of waiting seats required. The model concluded that the number of waiting seats in the design was adequate; however, the seats were not allocated to the correct spaces. For example, the clinics on the third floor had more seats than necessary while the clinics on the fourth floor had fewer seats than necessary. The model was useful in determining the appropriate number of seats in each waiting area. Future evaluation will be made to assess if the number of seating calculated was adequate.

KEYWORDS: operations modeling, simulation, space programming, healthcare, right-sizing

1.0 INTRODUCTION
Waiting spaces are often a patient's first impression when visiting a clinical department or physician office. Creating adequate spaces that decrease the amount of stress and anxiety are important. Waiting rooms can vary in size, depending on the practice size, and in some cases the waiting rooms are shared between departments[1]. Patients are most satisfied when their wait is brief and the physician spends more time with them[2]. This article discusses the use of process modeling to calculate the size of waiting spaces for the many services offered at a medical office building addition. The building is designed to meet the health care needs of over 13,000 University employees and 15,000 students, as well as the residents of the surrounding communities. The facility will feature a variety of specialties including: oncology, medicine, physical rehabilitation, women's health, men's health, surgery, radiation oncology, cardiovascular, neuromuscular, ophthalmology, and oral surgery. The center will feature 110 exam rooms, four ambulatory operating rooms, two procedure rooms, one endoscopy suite, cancer treatment unit, linear accelerator, and an imaging and diagnostic center. The analysis is essential to ensure enough seats for all patients and their companions in waiting areas because poor design works against the well-being of patients and in certain instances can have negative effects on physiological indicators of wellness[3]. This article outlines the methodology for using process modeling to determine space requirements. Process modeling is also useful in:

- Validation of space programming numbers
- Simulating processes to optimize schedules
- Simulating processes to determine number of providers needed
- Simulating processes to calculate the amount of space needed[4].

The analysis entails comparing the space requirements under the current planned schedule, as provided by the client, as well as under a staggered schedule, designed to reduce the number of spaces needed in the waiting area.

The approach with process modeling is different from the standard approach for space programming that is generally used by architects and facility planners. Space programming typically involves review of key planning units, such as patient volumes, and forecasts of future patient volumes. Those volumes are then utilized in determining the number of spaces needed, such as patient care rooms, clean utility rooms, visitor kitchens, staff lounges, and waiting areas. The approach with process modeling is different because this approach reviews the process and the number of spaces needed to accommodate the process. A traditional programming approach does not consider process as the main driver, but instead volumes as the main driver. A process modeling approach uses the operational process, or workflow as the main driver of facility size. For example, a traditional programming approach would not consider staggering provider schedules to minimize the number of spaces needed in the waiting area. This article will discuss the modeling approach to facility programming for waiting areas, and the results of applying this approach at one facility.

2.0 METHODOLOGY

2.1 Data Collection

To complete the process modeling for the medical office building, the Perkins+Will team worked collaboratively with the Management Engineering group for the health system to obtain data on current patient volumes, as well as projected future patient volumes for each service area. Additionally, the group provided projections on number of providers, length of stay for patients, and turn times for each step of the treatment process for each service area, as noted in Figure 1. Health System clinicians provided data on the number of companions that patients bring with them on their visits. Architects from Perkins+Will provided planned counts of exam rooms and shared spaces by traditional programming methods.

2.2 Tools and Techniques

To develop the analysis model, several additional tools and techniques were utilized. First, a review of all data was conducted to ensure the information was accurate.

3rd Floor Sports Medicine Clinics	**Current Year**	**Year 2023**
Hours of Operation	8am to 5pm	8am to 5pm
Hours per Day	8	8
Volumes		
Average Providers/hour (8 hr day)	2	3
Average Patients/Provider/day (8 hr day)	40	40
Average Patients/Provider/hour (8 hr day)	5	5
Total Patients/hour (8 hr day)	10	15
Total Patients/day	80	120
Business Plan Volumes (Average/day - 260 days/year)		
…l Patients	13,400	25,800
[illegible]	[illegible]	[illegible]

Figure 1: Sample data overview – Sports medicine clinics.

For example, one radiology fluoroscopy room was allotted to treat 75 patients per day with a length of stay of 60 minutes per patient. To service this many patients with the designated length of stay, more than one fluoroscopy room would be needed. Discrepancies such as this were submitted to the clinical team for further investigation.

Observational studies were conducted to determine existing patient flow and processes. Process flow charts were developed to visualize the flow of patients through various areas of the clinic. These flow charts were overlaid with statistical analyses to determine the probability of patients flowing through each pathway.

Next, statistical analyses were performed to determine the inputs to the process modeling. For example, the team had to determine the number of companions that would be present at each clinic with each patient. Some patients arrived with no companions, while others arrived with more than two companions. The team performed an analysis of the data to estimate the number of companions that would arrive with any given patient. Additionally, some companions accompany the patient in the exam room while other companions continue waiting in the waiting area. The team calculated the probability of companions remaining in the waiting area, and included those calculations in the determination of the waiting area size.

The process modeling was then completed to determine the number of seats needed in each waiting area at each hour of the day.

2.3 Waiting Space Needs

Process cycle times were provided by Health System personnel. For example, the process cycle times utilized for the sports medicine clinic are outlined in Figure 2.

Patient and provider volumes were also provided by Health System personnel, and reflected projected volumes for the year 2023, as shown in Figure 1.

Health System clinical personnel retrospectively collected data on the number of companions that accompanied patients and provided this to the design team. This data was used to compute the average number of seats needed for companions in the waiting area. For example, the sports medicine clinic identified that 45 percent of the time, the patient presented to the clinic alone, while 35 percent of the time, the patient presented with one companion, and 20 percent of the time

Process / Location	Time
Registration desk	10 minutes
Exam room	20 minutes (10 minutes with physician, 10 minutes with other providers)
Lobby wait time	50 minutes
Checkout	10 minutes
Total Length of Stay	**90 minutes**

Figure 2: Process cycle times for patients' visits.

the patient presented with two companions. Therefore, the average number of seats needed for companions was computed as:

(0 companions x 45%) + (1 companion x 35%) + (2 companions x 20%) = 0.75 seats

This number of seats was then adjusted based on the phase of the patient's visit, as some companions accompany the patient to the exam room, while others continue to wait in the waiting area. Health System clinical personnel collected data on the number of companions accompanying the patient to the exam room, and identified that 87 percent of companions accompanied the patient to the exam room. Therefore, the calculation to measure the number of seats needed in the waiting area for companions during the time the patient is in the exam room was computed as:

(0.75 seats x 13% of companions remain in the waiting area) = 0.1 seats

Therefore, 0.1 seats are needed in the waiting area for each patient during the time the patient is in the exam room. A similar analysis was completed for each phase of a patient's visit.

The process modeling was completed in a Microsoft Excel spreadsheet by modeling provider schedules against patient appointments. For example, Figure 3 shows the analysis for the sports medicine clinic with three providers and each provider using four exam rooms.

To explain Figure 3, the patient represented by the box outlined in blue will be featured. Each patient starts his visit with registration, indicated by the grey color, with 0.75 seats needed in the waiting area for the patient's companions for the time the patient is in registration.

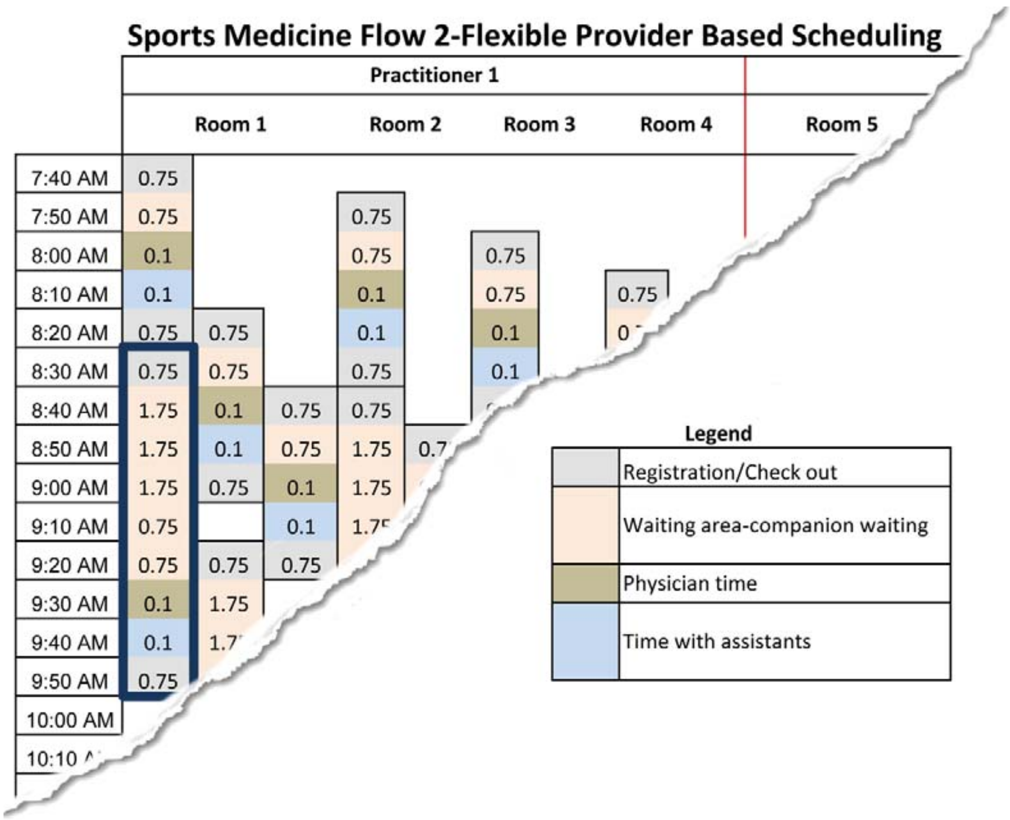

Figure 3: Example of schedule used in the analysis process, in relation to the necessary seat area needed in the waiting room.

Next, the patient and his companions wait in the waiting area, as indicated by the peach color with the value of 1.75 seats needed (one for the patient and 0.75 for companions). Next, the patient will be called to a separate testing area to complete testing. During this time, the patient's companions stay in the waiting area, as represented by the peach color with a value of 0.75 seats needed. After the patient completes the initial testing, the patient is taken to an exam room where he sees the physician, indicated by the olive color. There is a need for 0.1 seat in the waiting area during the time that the patient is seeing the physician because some companions do not accompany the patient to the exam room to see the physician. Next, the patient is treated by assistants while in the exam room, as indicated by the light blue color. Similar to the time that the patient is with the physician, there is still a need for 0.1 seats in the waiting area for the companions that do not accompany the patient to the exam room. Finally, the patient spends time at the check-out desk, indicated again by the grey color. Since companions generally return to the waiting area during the time that the patient is at the check-out desk, there is a need for 0.75 seats in the waiting area for the companion.

The analysis identified that the waiting space for the sports medicine clinic needed to accommodate 24 seats at the busiest time of the day. The planned number of waiting space seats was 32, an excess of 8 seats more than necessary.

In addition to defining the waiting space needs, alternative schedules were also explored to analyze the possibility of changes to provider schedule. Specifically, shifting provider start times so that all providers are not starting at the same time revealed that the waiting space requirements could be reduced. For example, Figure 4 shows the analysis for the sports medicine clinic with three providers and each provider using four exam rooms, as before; however, in this analysis provider start times were shifted by 30 minutes. Subsequently, at the end of the day, provider one finishes 30 minutes before

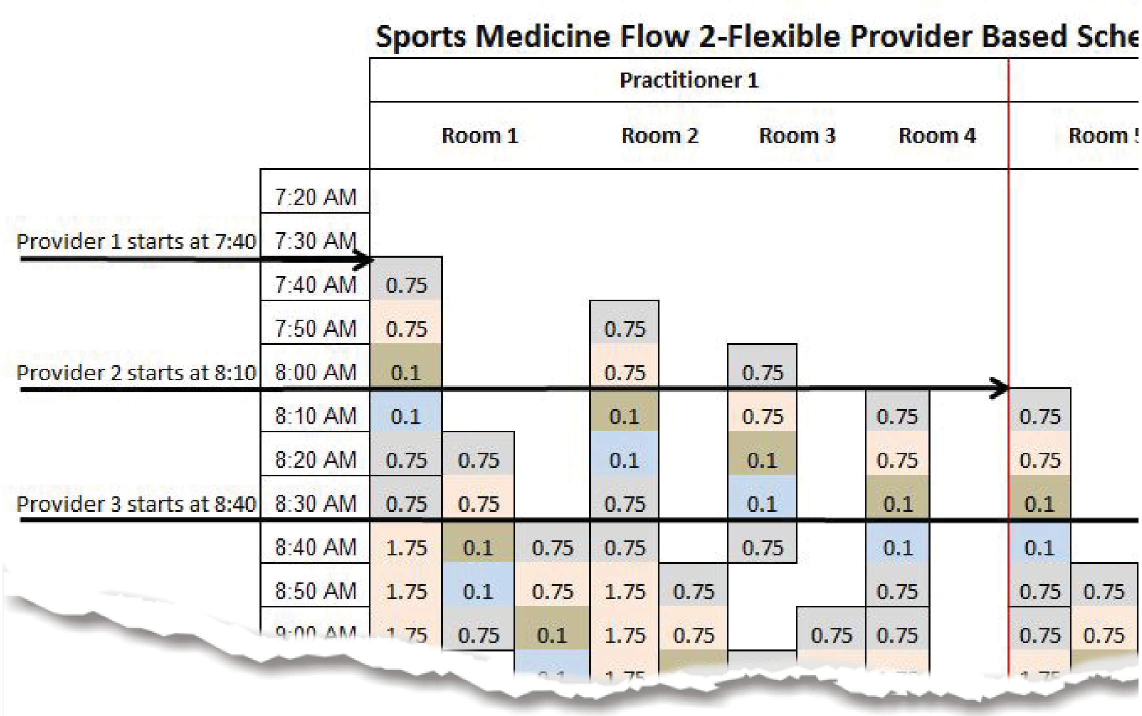

Figure 4: Scheduling for different service providers.

provider two and one hour before provider three. Therefore, the clinic is open one hour longer than it is currently open, yet providers are working the same number of hours.

The result of shifting provider start times was a reduction of waiting area seats to 22, a decrease of two seats for this one clinic.

A summary of the findings for the third floor clinics is displayed in Table 1.

The figure above summarizes the findings, which ranged from a shortage of six waiting space seats to an excess of eight waiting space seats by area.

In summary, the building was designed with the same number of waiting area seats; however, the seats were

Table 1: Third floor clinics.

	Number of Waiting Spaces...	Sports Medicine	Neuro-muscular & Skeletal	Eye Clinic	Family Internal Medicine	Oral Surgery	Cardiology	Total
Plan	from plan	32	18	Indepen-dent design**	36			86
Analysis	required from baseline physician scheduling	24	24	35***	33	9	8	98***
	required from variable physician scheduling	22	25	30***	27	8	8	
Total	Surplus/(Deficit) for maximum patient census	8	(7)	Not Included	(14)			**(13)***

*A contingency of 18 spaces for overflow is included in design resulting in an overall surplus of five seats.
** Appropriate numbers for eye clinic waiting space were designed by the Health System's in-house expert.
***While the analysis was completed for the Eye Clinic, the numbers were not included in totals.

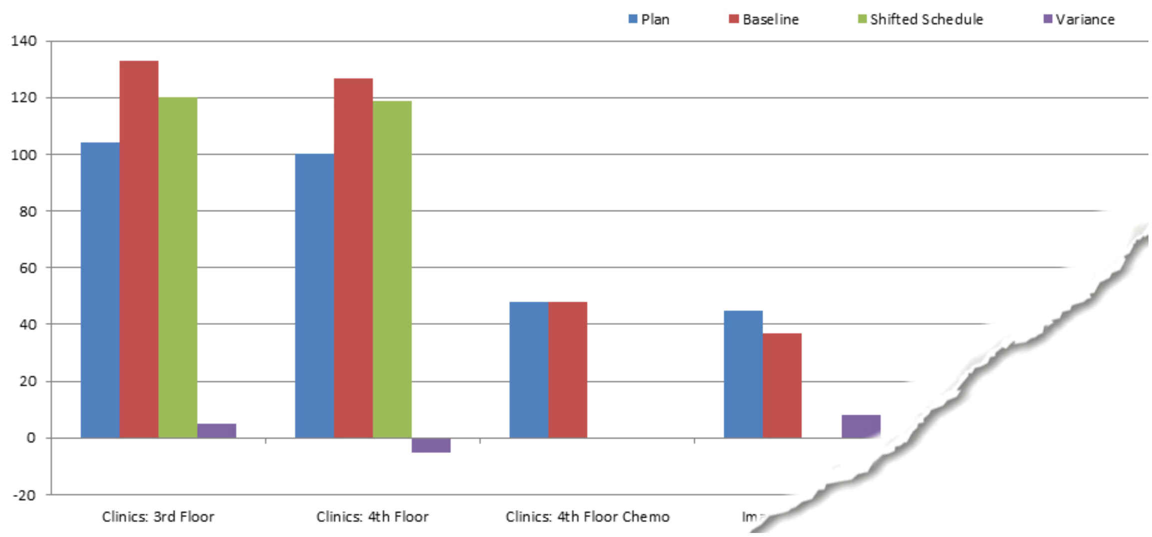

Figure 5: Summary of findings, (waiting seats by departments).

not allocated to the waiting areas based on need. For example, the clinics on the third floor had more seats than necessary while the clinics on the fourth floor had fewer seats than necessary. The variance bars below zero in Figure 5 indicate too few waiting seats while the variance bars above zero indicate more seats than needed.

3.0 CONCLUSION

The study found that there were excess seats in the waiting areas for the third floor clinics, first floor imaging, and surgical services. There was a shortage of seats in the waiting areas for the fourth floor clinics, third floor imaging, fourth floor imaging, and urgent care. The number of seats in the waiting area for the fourth floor chemotherapy unit matched the process model exactly. While the building contains enough waiting area seats, the seats are not allocated to the waiting areas based on need.

Process modeling is useful in many scenarios:

- Validation of space programming numbers
- Simulating processes to optimize schedules, to determine number of providers needed and to calculate the amount of space needed.

Since developing the process model for this Health System, the Perkins+Will Healthcare Planning + Strategies team plans to reuse the model on a current project for a cancer center. The model will be used to validate the space programming numbers planned from traditional programming based on projected volume and length of stay metrics.

REFERENCES

[1] Haggerty, L., (2010). "Designing Comforting, Caring Waiting Spaces", *Healthcare Design,* March 4.

[2] Anderson, R., Camacho, F. and Balkrishnan, R., (2007). "Willing to Wait?: The Influence of Patient Wait Time on Satisfaction with Primary Care", *BMC Health Services Research.*

[3] Ulrich, R., (1991). "Effects of Interior Design on Wellness: Theory and Recent Scientific Research", *Journal of Health Care Interior Design,* Vol. 3, pp. 97-109.

[4] Borshchev, A., and Filippov, A., (2004). "From System Dynamics and Discrete Event to Practical Agent Based Modeling: Reasons, Techniques, Tools", *Proceedings of the 22nd International Conference of the System Dynamics Society,* Oxford, England.

02.
POSITIVE DISTRACTION AND AGE DIFFERENCES:
Design Implications for Pediatric Healthcare Environments

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ABSTRACT
This study was conducted as part of an existing facility evaluation before design of a specialized pediatric clinic in Northern Virginia. The goal of the study was to investigate the positive distraction techniques staff use for pediatric patients during medical visits, and the possible role of the built environment in supporting these techniques. Applicability of each technique for different pediatric patient age groups, ranging from infants to 19 year olds was studied.

A retrospective survey method was used for data collection. Thirty-six staff completed the survey and responded to questions regarding various distracting techniques used and sources of disruptive noise. Results showed a significant difference in type and frequency of distraction techniques used for different age groups. Research findings suggest the need for establishing design guidelines that accommodate alternate methods of distraction as well as the needs and preferences of different pediatric age groups.

KEYWORDS: children outpatient clinic, decoration, color, environmental stimuli

1.0 INTRODUCTION

1.1 Previous Research

In 2010, the design and fit-out of a specialty pediatric cardiac clinic in Washington DC was completed. The 11,000 square foot clinic within an existing hospital was relocated to the new space which was created to support: increased access to daylight, improved staff respite areas, improved acoustics, improved wayfinding through pattern and color, improved staff and patient flow, and appropriate design for multiple patient types including expectant mothers, children, adolescents and adults with congenital heart conditions.

The design team conducted pre- and post-occupancy evaluation surveys to assess effectiveness of design in addressing project goals. The hypotheses were (1) incorporating daylight in corridors, staff work areas, and the waiting room would improve staff satisfaction; (2) strategic use of color and pattern along main paths of travel would improve wayfinding; and (3) utilizing a subtle color palette and non-childlike imagery would appeal to all patient types.

In 2010, 43 staff members responded to an online questionnaire in the existing clinic space. After three months in the new space in 2011, 48 staff members completed the same online survey. The results demonstrated a positive trend when comparing the old and the new facilities on the topics of access to daylight, wayfinding, and a cheerful but non-childlike design[1].

After completion, the design team was hired to design an additional specialty pediatric clinic for the hospital, an outpatient facility outside the main hospital campus. The team was convinced to incorporate similar design features into the new clinic based on the previous findings. However, the design team's questions regarding appropriate color palette and appropriate use of childlike imagery were still unanswered. Healthcare environments tend to use color, pattern, and childlike imagery liberally to provide positive distraction in pediatric patients to reduce perceived pain and stress. While findings of the pre- and post- occupancy evaluation in the prior clinic showed a subtle color palette was preferred by staff, the design team questioned: (1) Is the liberal use of color, patterning and child-like imagery the foremost means of positive distraction for pediatric patients and; (2) If a successful means of positive distraction is the profuse incorporation of color, decoration, and child-like imagery; are they appealing to all pediatric age groups?

1.2 Ethical Considerations

This study was exempt from the Institutional Review Board's full review because the research protocol imposed minimal risk to participants, did not include vulnerable groups, and ensured anonymity of participants. The study was approved by the clinic's facility manager.

1.3 Review of the literature

In 2006, Dijkstra, Pieterse, and Pruyn reviewed literature pertinent to healthcare design and patient outcomes and concluded that ambient elements and design features can impact severity of pain, stress, and anxiety[2]. Available research shows that distraction from medical examination or procedure can decrease feelings of pain, fear, and distress through reducing the regional cerebral blood flow and mental capacity to process pain[3,4,5]. While several interventions can contribute to patient distraction, research often supports use of positive distraction in a healthcare setting, which can reduce patient stress, as well as negative feelings and thoughts[6, 7, 8].

Generally, activity oriented positive distractions are used with children during a medical examination, to keep them occupied. For example, in 1994, Vessey, Carlson, and McGill studied children three-and-a-half to 12 years old who were undergoing blood draws and found that using a kaleidoscope during the procedure could decrease reported pain[3]. Distraction through touch and bubble blowing has also shown to decrease pain reported by children during injections[9].

Non-activity oriented distractions include the incorporation and manipulation of various physical elements such as color, light, texture, shape, pattern, and scale, which can create stimulating environments for children. These design interventions intended to provide positive distraction for children, however, sometimes are based on an adult's perception of a child's ideal environment or preferences of healthy children. This may lead to disproportionate amounts of brightly colored pediatric healthcare environments[10]. It is noteworthy that adult perceptions are not a true indicator of children's preferences[11]. Additionally, pediatric patients may be experiencing negative emotional states, which may lead to reactions to environmental stimulation that are different than those of healthy children[12].

For patterns and decorations, in 2006, Blumberg and Devlin showed that blatant symbols of childhood are not favored by children and adolescents ages 10 to 19 years of age[13]. Color studies show that preferences also change with an individual's age[14, 15, 16] and over time as children develop[17,18]. Distinctions should be made between strategic use of color as a visual cue for wayfinding or positive distraction, and overstated use of colorful patterns. While the former can create a visually soothing environment, the latter may increase stress and mental chaos through information and sensory overload.

1.4 Problem Statement and Research Hypothesis

In creating healing healthcare environments for children, additional research is needed to better understand children's preferences and needs. Much of the available research on healthcare environments has focused on healthy adults or adult patients and cannot be applied with confidence to pediatric healthcare environments. Moreover, little research is available regarding appropriate environments for pediatric patients, while making a distinction between younger children and adolescents.

With this background, the following statements were hypothesized: (1) positive distraction techniques used by clinical staff vary per patient age group and (2) positive distraction techniques are not exclusively visual elements dependent on the built environment.

2.0 RESEARCH METHOD

A survey was distributed to staff in the existing specialty pediatric outpatient clinic in May 2012. Seventy two percent of staff completed the survey. The survey was developed by authors and included 10 questions and covered three main constructs: (1) respondent demographics, (2) distraction techniques used for each patient age group, and (3) staff perception of patient noise level. Before the survey was administered, a nurse staff reviewed the questions to ensure suitability of the questions.

Staff demographics: This item included staff gender, role, age, and years of work at the clinic. The surveys were distributed anonymously and no data that could identify the participants by name was collected.

Distraction methods: Pediatric patients were categorized in four age groups:
1. under two years old,
2. between two and six years old,
3. between seven and 12 years old and
4. between 13 and 19 years old.

Staff were asked to indicate the distraction techniques employed for each patient age group. The distraction techniques were derived from the literature. A senior nurse staff reviewed the survey and confirmed appropriateness of the items provided in this question. These items included: "Point at decorations and patterns", "Get help from parents", "Point at views from the window", "Use toys and other objects", "Talk to them", "Sing to them", and "Encourage relaxation and breathing" (Figure 1).

Displays of discomfort: Healthcare practitioners use various scales to assess levels of pain and stress experienced by patients. Such tools are generally intended for young children, sedated patients, or the cognitively impaired, who are unable to communicate discomfort verbally. Examples of scales include: FLACC scale[19], CRIES[20], and COMFORT[21]. These tools rate various indicators, such as crying, physical movement, muscle tone, and facial tension to rate level of pain perceived by patients. "Crying" was the only category used in all of these assessment tools, and, more specifically, it has been used as the sole representation of levels of perceived pain in Baker Faces Pain Scale[22]. Thus, to measure overall levels of perceived pain and stress in patients, staff responded to questions regarding noise levels in the clinic and the percentage of that noise originating from patients crying in the exam rooms or waiting area.

	Children Under 2 Years old	Children Under 2-6 Years old	Children Under 7-12 Years old	Children Under 13-19 Years old
Usually don't distract	____	____	____	____
Point at decorations and patterns	____	____	____	____
Get help from parents	____	____	____	____
Point at views from the window	____	____	____	____
Use toys and other objects	____	____	____	____
Talk to them	____	____	____	____
Sing to them	____	____	____	____
Encourage relaxation and breathing	____	____	____	____
Other ________	____	____	____	____

Figure 1: Sample survey question.

3.0 RESULTS

3.1 Research Population Demographics

Seventy-two percent of staff who were asked to participate returned their completed surveys within two weeks. Among the 36 respondents, 33 were female and three were male. More than 61 percent were between 22 to 45 years of age, around 33 percent were between 45 to 64 years of age, and the remaining where over 65 years old. Thirty-six percent of respondents were administrative staff, 36 percent were identified as a nurse, nurse practitioner, or technician, and 13 percent were physicians, 3 percent were psychologists and the remaining selected “other” as their functional role in the clinic.

3.2 Sources of Noise

Staff were asked to rate sources of disruptive noise within the clinic on a 5 point scale, with “1” being less disruptive and “5” being the most disruptive. Staff reported children playing in the waiting area (3.5), children crying in the waiting area (3.4), and children crying in the exam rooms (3.4) as the major sources of disruptive noise in the clinic. Noise of people talking in corridors (2.9) and equipment (1.7) were not as disruptive as children crying or playing (Figure 2). In general, reported noise levels were moderate in all areas mentioned in the question: exam rooms were rated 2.6, staff offices were also rated 2.6, and the waiting area was rated 2.9.

3.3 Positive Distraction Techniques Used

Figure 3 represents a summary of staff responses to the question “How often do you distract patients during a medical visit?” per age group. Forty-four percent of staff said most of the time they distract children under the age of two during a medical visit. Only 2.7 percent of staff said that they distracted adolescents, patients between 13 to 19 years olds, “Most of the time”. Overall, Figure 3 compares frequency of each distraction techniques used for different age groups. Distraction is more frequently employed for patients under six years of age compared to patients seven and older.

Figures 4 through 7 demonstrate distraction techniques staff employed per age group. It is noteworthy that while a wide variety of methods are used for patients six years old and younger (Figure 4 and 5), only two techniques are typically used to distract adolescents ages 13 to 19: “talk to them,” and “encourage relaxation and breathing” (Figure 7). In the case of patients six years old and younger, “point at wall decorations and patterns”, “use toys and other objects”, “get help from parents”, and “talking” provided the major means of distraction from the medical visit. These techniques were followed by “point at views form the window”, “sing to them”, and “encourage relaxation and breathing” (Figure 4 and Figure 5). For children 7 to 12 years old, The same variety observed for younger children is present, however, a larger emphasis is put on “talk to them” and “encourage relaxation and breathing”, similar to children 13 to 19 years old (Figure 6).

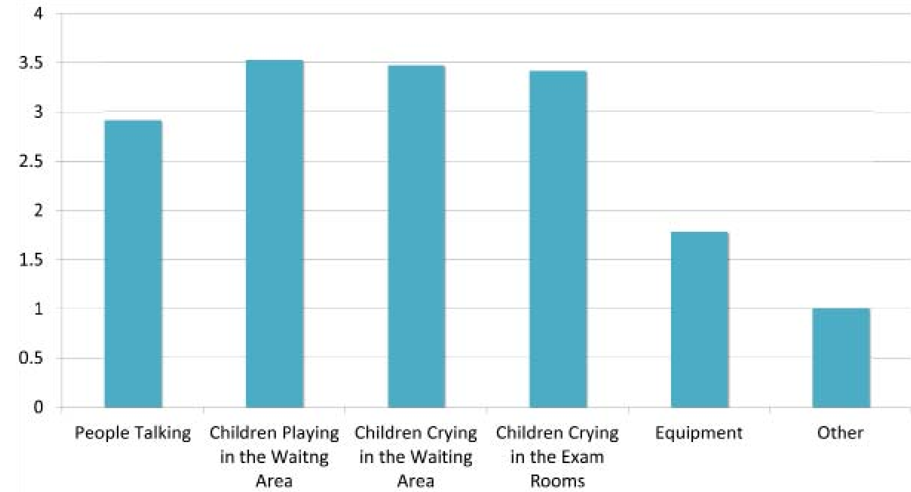

Figure 2: Sources of disruptive noise rated by staff.

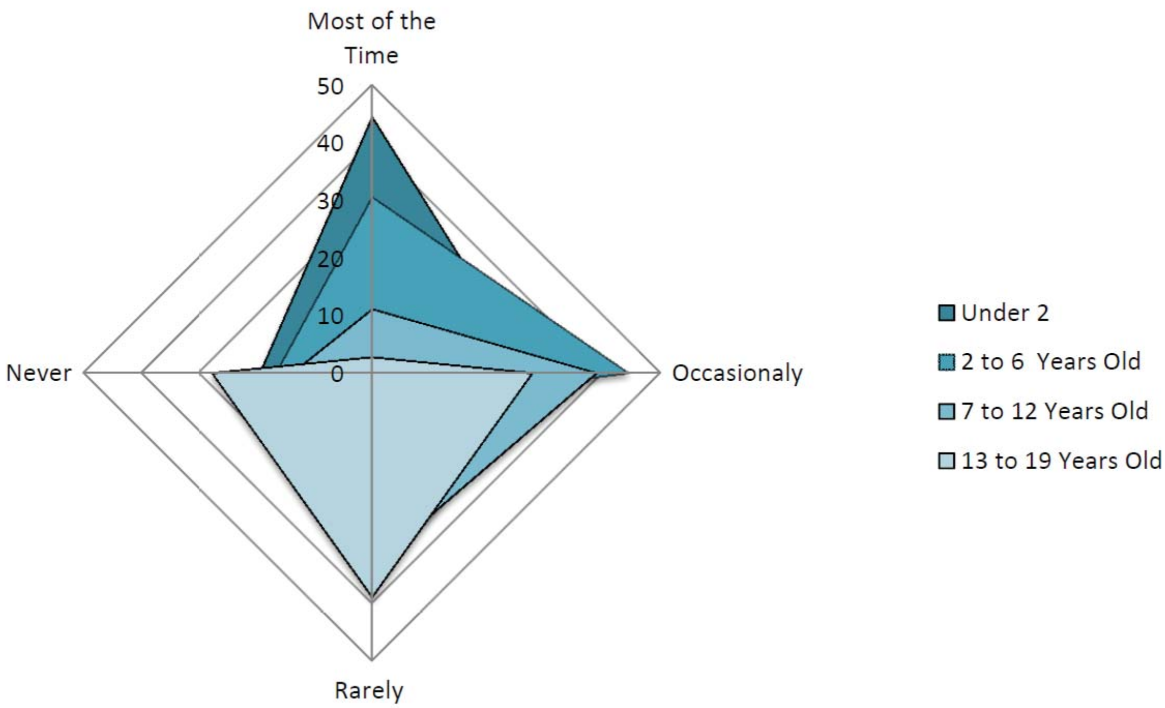

Figure 3: Frequency of distraction used during medical visit for each age group.

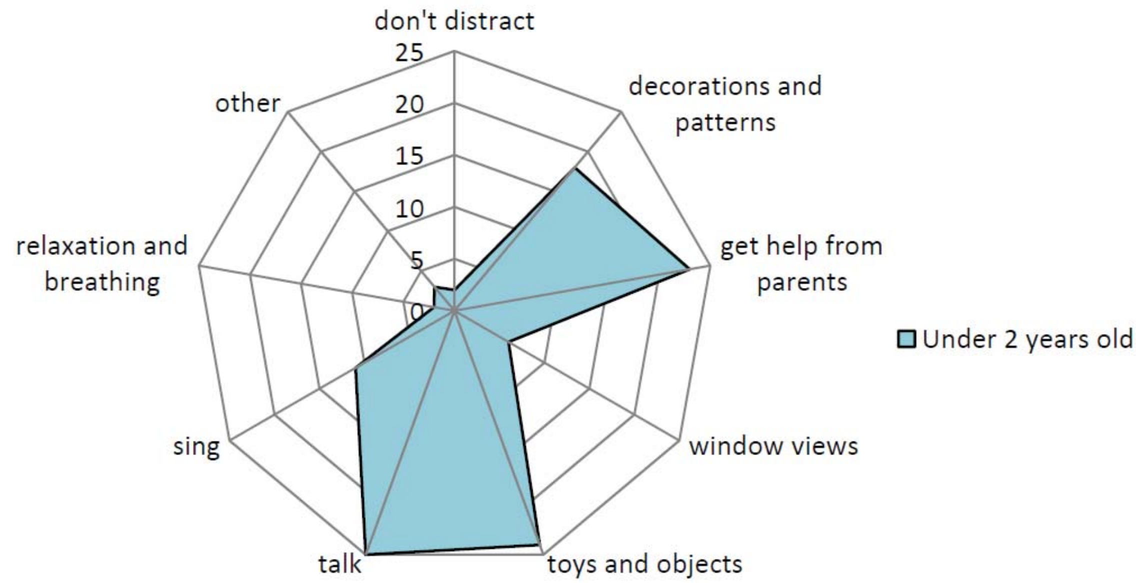

Figure 4: Distraction techniques used for children under 2 years old.

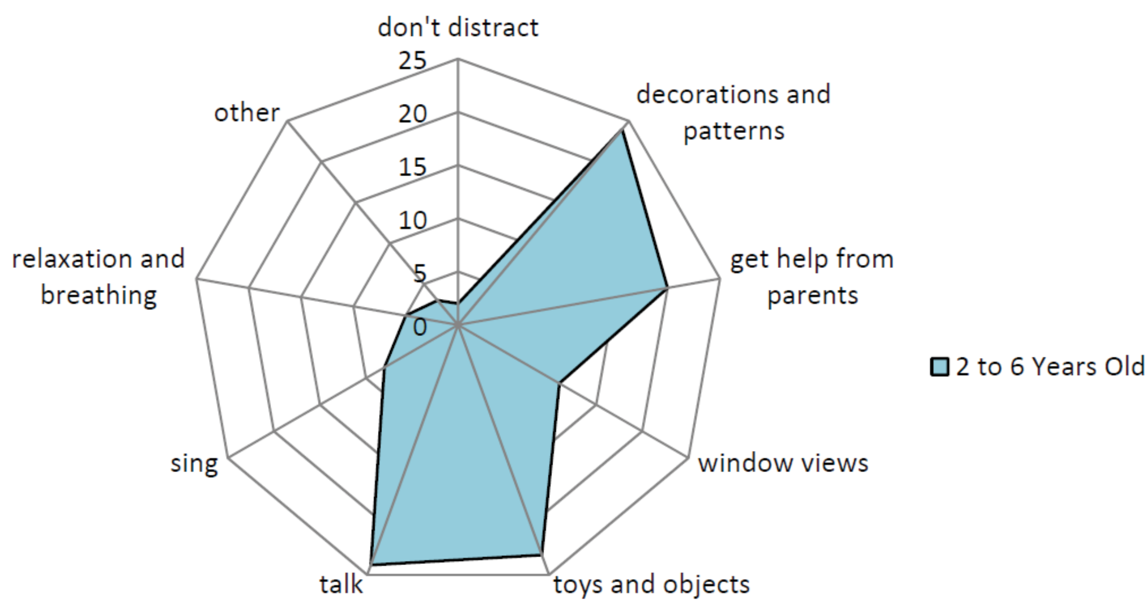

Figure 5: Distraction techniques used for children 2 to 6 years old.

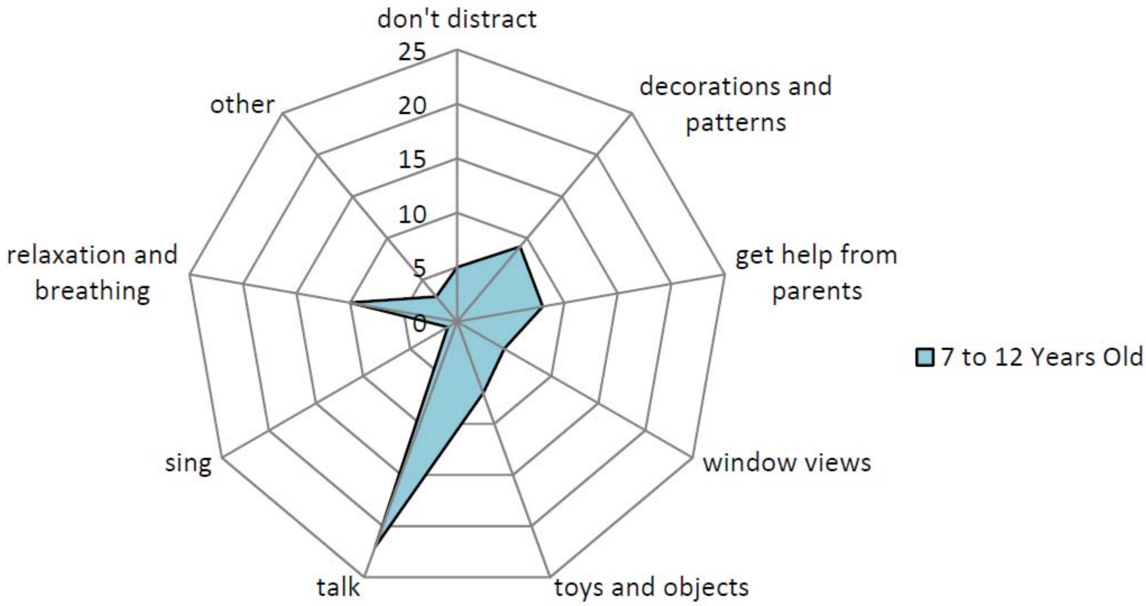

Figure 6: Distraction techniques used for children 7 to 12 years old.

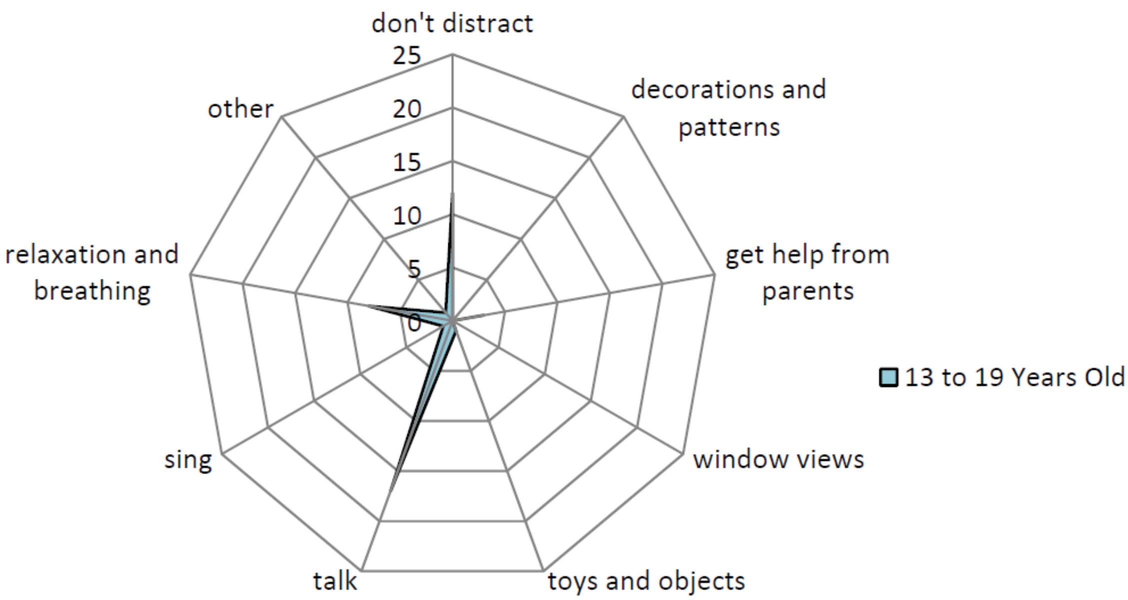

Figure 7: Distraction techniques used for children 13 to 19 years old.

Table 1: Table of frequencies for distraction techniques used per age group.

	Group 1					Group 2		
	talk	use toys and objects	get help from parents	sing	encourage relaxation and breathing	point at window views	point at wall decorations and patterns	don't distract
Under 2	25	24	23	11	2	6	28	2
2 to 6	24	23	20	8	5	11	24	2
7 to 12	22	7	8	1	10	5	9	5
13 to 19	17	1	3	1	8	0	0	12

A contingency table (Table 1) was created, which compared the frequencies of each technique used for each age group. The techniques are organized in two groups; group 1 consists of techniques that can be independent from the physical environment, and groups 2 includes techniques that are more directly related to the built environment.

4.0 RESULTS

This study investigated pediatric patient discomfort during a medical visit from two different perspectives: (1) Patient display of discomfort through crying and (2) staff techniques to reduce patient discomfort through positive distraction.

Analysis of data pertaining to noise level showed “children crying” as a major source of noise in both exam rooms and waiting area. This can indicate the level of discomfort or stress among the patient population. Staff responses to questions regarding frequency of distraction technique use revealed that some form of distraction is more commonly practiced for patients six years old and younger. Most staff responded they distracted patients older than seven “occasionally” or “rarely”. Staff used a variety of distraction techniques comprised of activity-oriented, auditory, and visual distractions for younger children. However, for adolescent patients, staff only talked to them or encouraged breathing for relaxation. Future research may focus on studying alternate distraction techniques for adolescents and respective effectiveness.

Results of this study showed that, in terms of distraction technique types and frequencies, adolescents seem to be treated in a more adult-like fashion. Considering that adolescents tend to act more adult-like compared to younger children, it is unknown whether the techniques employed by staff are a response to adolescents’ perceived levels of stress and pain or their adult-like displays of stress and discomfort.

Responses to the question regarding types of distraction techniques employed showed that wall decorations and patterns are only one of several techniques used to create positive distractions for pediatric patients. Staff used such elements to distract younger patients and did not report using them for teenagers. Future studies should investigate the reasons for this. However, our speculation is that: 1) teenagers don’t need to be pointed at wall decoration to notice them; 2) such elements are not attractive for teenagers and may be perceived as too juvenile.

This research was conducted as a part of a pre- and post-occupancy evaluation for the new clinic. One limitation of this study is utilizing surveys as the only research method. Behavior observations in the waiting area and exam rooms could have better captured the effectiveness of distraction techniques used. Another limitation of the study, which was imposed by time and staffing constraints, is the retrospective nature of surveys. In this survey design staff responded to their general experience working with the patients in the past. Further research is needed to measure staff ratings for each individual patient concerning their age, gender, displays of pain and discomfort, and a relevant psychometric measure.

5.0 DESIGN IMPLICATIONS

Based on the findings of this study and recommendations of the available literature[23], design of pediatric healthcare settings should consider: (1) strategic use of decoration and patterning; (2) consideration and incorporation of alternate distraction techniques; (3) appropriate imagery for all age ranges; and (4) appropriate acoustics.

Strategic Use of Color: The results of the study supported the hypothesis that pattern and decoration is one tool among several others that are instrumental in providing positive distraction. Hence, pediatric design need not rely on wall decoration or patterning as only means of providing positive distraction. Clinical staff utilize a variety of techniques for distraction; thus, wall decoration, imagery, and patterning can be used strategically to address wayfinding or imperative distraction needs. In areas where decoration and pattern are not necessary to enhance wayfinding or delivery of care, reduction of such elements will avoid over stimulation.

Alternate Distraction Techniques: Design of the pediatric healthcare environments should be supportive of the diverse pool of positive distraction techniques used by staff. In areas where patients may feel discomfort, the design team should allow for additional interventions such as window views, storage of toys and objects easily accessible by staff, child scale and innovative furniture design, and music. Incorporating alternate distraction methods within the built environment will support strategic use of color, pattern, and decoration.

Appropriate Imagery: The significant difference observed between distraction techniques used for different age groups supports the hypothesis that different age groups have different needs and preferences. While staff can adjust their distraction method considering the age of each patient, the built environment remains constant. Observations from most pediatric care centers show a tendency to create environments that are thought to be appealing for younger children, while overlooking the needs and preferences of older children and adolescents.

In a pediatric setting with patients ranging in age from infancy to 19 years old, special attention should be paid to accommodate all patient age groups. Incorporating only child-like, overly simplistic imagery in a pediatric space may alienate teenagers, reducing satisfaction with their treatment.

Acoustics: Auditory distraction is often employed by staff through talking to patients, singing to patients and asking parents for assistance. As a result, designing to the right level of sound absorption will increase the effectiveness of these tasks and therefore foster better communication between staff and patients. Furthermore, pediatric settings with the proper acoustics will isolate disruptive noise from crying patients and subsequently can help reduce disruption and stress levels for staff and other patients and visitors.

6.0 CONCLUSION

Evidence based design has gained popularity in the past years, and has encouraged the practice of healthcare design to incorporate research findings into their decision-making process. The notion of research-informed design, however, is dependent on availability of research that can answer specific design questions. Often times, healthcare designers confront questions that are not addressed by the available body of research, are specific to their design problem or population, or are challenged by contradicting research findings. In such cases, and as part of the design process, designers may investigate best responses to their design questions through in-house research.

The present study is the first phase of a two phased study. The first phase aimed to answer a design question and generate design guidelines. The design guidelines were implemented in design and construction of the new facility. Through phase II, the new facility will be evaluated to assess the effectiveness of design in addressing the design objectives. The study provides an example for research-integrated design, through which, research answers the design questions, and design evaluation examines accuracy of research findings.

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REFERENCES

[1] DeGeeter, M. J., Lanes, H., (2011). "Designing for Health: Pre- and Post- Occupancy Survey Influencing Design", *Contract,* 23 March, Retrieved on 6/28/2012 from http://www.contractdesign.com/contract/design/features/Designing-for-Health-4664.shtml

[2] Dijkstra, K., Pieterse, M., and Pruyn, A., (2006). "Physical Environmental Stimuli that Turn Healthcare Facilities into Healing Environments through Psychologically Mediated Effects: Systematic Review", *Journal of Advanced Nursing,* Vol. 56, No. 2, pp. 166-181.

[3] Vessey, J., Carlson, K., and McGill, J., (1994). "Use of Distraction with Children During an Acute Pain Experience", *Nursing Research,* Vol. 43, pp. 369-371.

[4] Petrovic, P., Petersson, K. M., Ghatan, P. H., Stone-Elander, S., and Ingvar, M. (2000). "Pain-Related Cerebral Activation is Altered by a Distracting Cognitive Task", *Pain,* Vol. 85, pp. 19-30.

[5] Bantick, S. J., Wise, R. G., Polghaus, A., Clare, S., Smith, S. M., and Tracey, I. (2002). "Imaging How Attention Modulates Pain in Humans Using Functional MRI", *Brain,* Vol. 125, pp. 310-319.

[6] Ulrich, R. S., (1981), "Natural versus Urban Scenes: Some Psychological Well-Being", *Environment and Behavior,* Vol. 13, No. 5, pp. 523-556.

[7] Rubin H.R., Owens A.J. and Golden G., (1998). "Status Report (1998): An Investigation to Determine Whether the Built Environment Affects Patients' Medical Outcomes", The Center for Health Design, Martinez, CA.

[8] van den Berg A., (2005). "Health Impacts of Healing Environments: A Review of the Benefits of Nature, Daylight, Fresh Air and Quiet in Healthcare Settings", Foundation 200 years University Hospital Groningen, Groningen.

[9] Sparks, L., (2001). "Taking the "Ouch" Out of Injections for Children: Using Distraction to Decrease Pain", *American Journal of Maternal Child Nursing,* Vol. 26, No. 2, pp. 72–78.

[10] Coad, J., and Coad, N., (2008). "Children and Young People's Preference of Thematic Design and Colour for Their Hospital Environment", *Journal of Child Health Care,* Vol. 12, No. 1, pp. 33-48.

[11] Fraser, S., Lewis, V., Ding, S., Kellett, M., and Robinson, C. (eds) (2004). *Doing Research with Children and Young People,* London, UK: Sage.

[12] Carpman. J, R., and Grant. M, A., (1993). "Design that Cares: Planning Health Facilities for Patients and Visitors", Chicago, IL: American Hospital Publishing.

[13] Blumberg, R. and Devlin, A.S., (2006). "Design Issues in Hospitals: The Adolescent Client", *Environment and Behavior,* Vol. 38, No. 3, pp. 293-317.

[14] Beke, L., Kutas, G., Kwak, Y., Young Sung, G., Park, D. S., and Bodrogi, P., (2008). "Color Preferences of Aged Observers Compared to Young Observers", *Color Research & Application,* Vol. 33, No. 5, pp. 381–394.

[15] Milne, L. C., and Greenway, P., (1999). "Color in Children's Drawings: The Influence of Age and Gender", *The Arts in Psychotherapy*, Vol. 26, No. 4, pp. 261–263.

[16] Zentner, M. R., (2001). "Preferences for Colors and Color—Emotion Combinations in Early Childhood", *Developmental Science,* Vol. 4, No. 4, pp. 389-398.

[17] Dittmar, M., (2001). "Changing Color Preferences with Ageing: A Comparative Study on Younger and Older Native Germans Aged 19-90 years", *Gerontology,* Vol. 47, No.4, pp. 219-226.

[18] Meerum Terwogt, M., and Hoeslma, J. B., (1995). "Colors and Emotions: Preferences and Combinations", *Journal of General Psychology,* Vol. 122, No. 1, pp. 5-17.

[19] Merkel. S. et al. (1997). "The FLACC: A Behavioral Scale for Scoring Postoperative Pain in Young Children", *Pediatric Nursing,* Vol. 23, No. 3, pp. 293-297.

[20] Bildner, J., (1996). "CRIES Instrument Assessment Tool of Pain in Neonates", Distributed by the City of Hope Pain/Palliative Care Resource Center.

[21] Ambuel, B., Hamlett, K.W., Marx, C.M., and Blumer, J.L., (1992). "Assessing Distress in Pediatric Intensive Care Environments: the COMFORT Scale", *Journal of Pediatric Psychology,* Vol. 17, No. 1, pp. 95-109.

[22] Baker, C. and Wong, D., (1987). "Q.U.E.S.T.: A Process of Pain Assessment in Children", *Orthopedic Nursing,* Vol. 6, No. 1, pp.11-21.

[23] Shepley, M., Fournier, M., and McDougal, K., (1998), *"Healthcare Environments for Children and Their Families."* Dubuque, IA: Kendall/ Hunt Publishing Company.

03.
ARCHITECT'S PROFESSIONAL LIABILITY RISKS IN THE REALM OF GREEN BUILDINGS

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ABSTRACT
Buildings are defined as "green" when specific measures are incorporated to provide healthier environments for their users and mitigate their negative impact on the environment. The practice of green building has caused significant changes in the construction industry, exposing architects to new legal liabilities. The objective of this paper is to investigate, identify and clarify the understanding of architects' professional liability risks associated with the design and construction of green buildings and how to manage those risks. By discussing information and resources gathered from journal articles, books, standard contracts documents, and white papers, this paper analyzes how architects' duties are effected by green building and certification standards, the new considerations to the Standard of Care, issues and potential liability risks, and new contract language. After discussing each potential risk, this paper provides ideas on what architects should do to mitigate these possible risks. This paper's conclusions indicate that architects must understand their roles, responsibilities, and potential liability when participating in the design and construction of green buildings to protect themselves against potential losses while practicing innovation.

KEYWORDS: architects, green building, risk management, liability, LEED certification

1.0 INTRODUCTION

A green building is one that is designed, constructed, and operated to minimize its negative impact in the environment. The U.S. Environmental Protection Agency (EPA) has described green building as "the practice of increasing the efficiency with which buildings and their sites use and harvest energy, water, and materials; [while] protecting and restoring human health and the environment throughout the building life-cycle"[1].

Since buildings in the United States are responsible for 72 percent of electricity consumption, 38 percent of CO_2 emissions, 38.9 percent of primary energy use, 13.6 percent of potable water consumption, and generate 136 million tons of construction debris[2], architects, construction professionals, owners, and government officials are taking this issue seriously.

Based on numerous studies about climate change and advocacy for a cleaner world[3], green buildings have emerged as a solution to reduce energy and water consumption, promote better indoor air quality, and divert construction waste from the landfills. In short, green construction has "become increasingly difficult to avoid"[4], and it is reasonable to assume that it is here to stay.

In 2000, the United States Green Building Council (USGBC) developed the Leadership in Energy and Environmental Design (LEED) Rating System, which "provides building owners and operators with a framework for identifying and implementing practical and measurable green building design, construction, operations and maintenance solutions"[5]. LEED has become the most widely used green building rating system in the United States and worldwide, and "is mentioned in the specifications for 71 percent of projects valued at over $50 million and 55 percent for all projects by value"[6].

Federal government agencies, states, and cities have been large contributors to the industry shift towards green building, in part, by requiring new government-owned or funded projects to comply with green building standards and often LEED certification. "Increasingly some states and municipalities are mandating compliance with Green Building Standards, mostly LEED Certification, for private development"[7], and many jurisdictions are offering incentives for sustainable projects. Examples of such incentives include expedited or reduced permitting fees, tax credits and rebates, and even refunds on LEED certification costs.

Green buildings are a driving force in the construction industry. It is estimated that the green construction market has created 2.4 million jobs between 2000 and 2008, and that number is projected to increase to over 7.9 million jobs by 2013[8].

2.0 ARCHITECTS' DUTIES

2.1 Architect's Basic Services

The scope of an architect's basic services[9] is defined in the professional services agreement negotiated between Owner and Architect. The American Institute of Architects (AIA) B101-2007 Standard Form of Agreement is the most common industry standard contract form.

Delineating between basic and additional services can be challenging. As of 2007, under Basic Services the architect is required to review and comply with laws, codes and regulations, and "shall discuss with the Owner alternative approaches to design and construction of the Project, including *the feasibility of incorporating environmentally responsible design approaches*"[10]. Because many jurisdictions have adopted green building codes, architects may not have a choice but to follow green principles or even pursue green certification as a requirement. Therefore, whether following jurisdiction requirements or satisfying owners' wishes to build green, architects providing green services should define more precisely the additional scope of work in an additional contract, as discussed below.

2.2 Architect's Additional Services for Sustainable Projects

On a sustainable project, "it is important to outline a clear scope of services in the Owner/Architect Agreement regarding the Architect's sustainable design duties and those to be undertaken by the owner and its consultants"[11].

AIA has developed the AIA B214 – 2004 Architect's Services: LEED Certification, "to help clarify a design professional's scope of services with respect to green building projects"[12]. Below is a summary of services to be provided by the architect under this contract:

- Determine Owner's Sustainable Objective - Architect shall conduct a predesign workshop with the owner and consultants to discuss the owner's intended use, goals and sustainable objectives for the project, and if certification is desired.
- Architect will develop a Sustainability Plan, according to owner's goals and objectives, that should include all the targeted points.
- Define Sustainability Measures necessary to achieve owner's Sustainable Objectives and identify project participants who are to be responsible for achieving each of them.
- Architect will manage the LEED documentation and certification process, including preparing online documentation, registering the project to be certified and providing clarifications required by LEED design and construction reviews.
- Architect shall include Sustainability Measures in contract documents, drawings and specifications provided for the project.
- Architect shall provide assistance to Owner and Contractor during the bidding and contract administration phases regarding LEED requirements or substitutions.
- Architect shall prepare a final LEED certification report.

2.3 Compensation

Architects may work on projects seeking green building certification or on projects intended to follow sustainable principles but not pursue certification. In all cases, architects should consider establishing a limit of what is included in their additional sustainable services. They should also establish compensation guidelines for contingent services arising during the normal course of the project,[13] since sustainable services may require multiple reviews of sustainability plan, additional unexpected meetings, and additional clarification responses to the Certification Authority organization.

3.0 STANDARD OF CARE CONSIDERATIONS

3.1 Professional Standard of Care

The Standard of Reasonable Care is the minimum expected of architects by law and "the most widely and generally accepted 'baseline' for evaluating the adequacy of design professional performance"[14]. AIA B101 defines this Standard as "the Architect shall perform its services consistent with the *professional skill and care ordinarily provided* by architects practicing in the same or similar locality under the same or similar circumstances. The Architect shall perform its services as *expeditiously* as is consistent with such professional skill and care and the orderly progress of the Project"[15]. Compliance with the Standard of Care is subjectively determined based on what a reasonable architect would or would not do under similar circumstances, and in a dispute, compliance or non-compliance could be decided in court. Therefore, any architect who is shown to have failed to exercise reasonable care may be held liable for professional negligence.

Architects must be familiar with the practices, codes, and regulations of the jurisdiction where the project is located and should avoid making changes to standard of care language. Even though it can be modified by contract or conduct, architects should stick to its minimum requirements, otherwise they increase their exposure to liability. Architect's professional liability insurance may not cover liability when contractual language used to define the standard of care imposes a duty of heightened performance upon the architect.

3.2 Changes to the Professional Standard of Care

As a result of construction industry shifts toward green building practices and government entities' moves toward more green design regulations, architects assume a greater level of expertise and responsibility, which may influence the standard of care. In 2007, AIA incorporated the "standard of care" in its contract documents "as the contractual 'benchmark' for professional performance and compliance"[16], although the standard of care was always applicable at law as the basis of determining professional negligence in comparison to the applicable norm of professional practice.

An increasing number of architects are becoming LEED Accredited Professionals (LEED AP) to understand the green building process and to prove qualification in that area as markets shift and competition increases. The LEED AP credential "provides a standard for professionals participating in the design and construction phases of high-performance, healthful, durable, affordable and environmentally sound buildings"[17]. This designation could become a new baseline for the standard of care for a professional who participates in sustainable projects. "It is not difficult to imagine that a design professional, who qualifies as a LEED Accredited Professional and touts itself as a green design expert in marketing or other promotional materials would be held to a higher standard of care"[18]. However, this could be problematic because insurance companies have yet to catch up with market changes. Many policies still often exclude coverage if an architect holds himself to a higher standard than the prevailing one. "Specifically-required performance objectives or warranty obligations regarding green/sustainable issues…may…exceed the customarily governing negligence-based professional standard of care…as well as pose potentially significant insurability concerns due to warranty exclusions contained in professional liability insurance policies"[19].

It is unclear what the Courts will do to determine the standard of care in a green building case. "No case law has definitely resolved the appropriate standard of care for such projects, but through analysis of existing common law and approved strategies for creating contractual relationships, a likely standard for court treatment begins to emerge"[20]. Carrying the LEED AP designation may be the minimum expected of a "green" architect, and the years of experience working with green buildings could be a reasonable determinant factor when comparing architects in terms of the standard.

"Certainly, it is difficult to find a comparative 'ordinary' performance for evaluation…in the current age of rapid innovation and evolution…Where these revolutionary and innovative products, processes, and performance criteria are part of a project, the standard of care must necessarily exist and be definable, but it is *not* 'business as usual'"[21]. As the industry changes, so will the standard of care. Sustainable design will likely become a basic service in the future, and therefore, the standard of care will eventually evolve to include this as a baseline. As a result, insurance companies will have no choice but to include green design as a covered design practice, since the new "sustainable" standard of care will constitute the new accepted baseline by the construction industry.

4.0 POTENTIAL PROFESSIONAL LIABILITY RISKS AND MITIGATION

Conventional buildings are designed and constructed to follow minimum requirements of the adopted building codes. Green building architects may design projects that incorporate features which exceed these minimum requirements, reaching for techniques and materials that are not necessarily the least expensive or common. Instead, they look for approaches that mitigate negative impacts of construction on the environment, even if these solutions are relatively new to the market. By extending their design efforts beyond minimal compliance with code, architects "may expose themselves to a number of potential pitfalls, thereby increasing their exposure to liability"[22].

Although the industry has not yet seen many legal cases involving green buildings, and courts have yet to establish precedent regarding green building claims, several construction and law professionals have been investigating risks specifically arising out of green construction. Their analysis of potential claims is based on how existing theories utilized in legal claims in the conventional construction setting might apply to the green building setting[23]. Studies have suggested that most claims would be based on breach of contract, fraud, or negligence[24].

The following are common issues and potential risks associated with the design and construction of green buildings that architects should pay attention to when participating in this area of practice. Recommendations on how to mitigate those risks are also discussed.

4.1 Communication

Risks will always exist in any project, conventional or green. "The greatest risk management tool is reaching understanding and clear communication between the architect, owner and contractor"[25]. When everyone clearly understands the risks associated with processes and materials in green building design, the risks in achieving (or not) green building certification and the operations and maintenance of green building systems, fewer claims will arise.

4.2 Client Expectations

Green buildings may result in benefits to the Owner, such as monetary incentives, lower operating costs, and improved marketability. However, there is "significant risk and liability exposure for the design professional arising from disappointed client"[26] because "the opportunities and benefits associated with green building also result in increased expectations…These failed expectations will result in disputes, claims, and litigations"[27].

Architects must clearly explain project team participants' roles and responsibilities to the Owner, and the architect's role regarding the achievement of sustainable performance standards and objectives. They must also explain that the success of a green building depends upon many factors, such as systems and products performance, on Contractor's utilized means and methods, on the selection of materials and systems, and on Owner's building operation and maintenance. Architects should seek to explain reasonably foreseeable impacts to schedule and cost and be diligent in documenting this process[28].

Even though "long-term costs for green construction may be less than for conventional buildings due to more efficient use of and more durable building materials"[29] green buildings can cost more initially than conventional buildings and architects should fully explain these potentially increased costs to the Owner and what he is getting in return[30]. For example, to maximize sustainability goals, more expensive materials and systems might be used and construction waste is often recycled[31]. Green building planning process is longer and requires the addition of new project participants, such as sustainability consultants, energy modelers and commissioning agent, and during operations it may require more specialized maintenance professionals[32].

Regarding LEED certification, the budget should account for LEED credit requirements, such as paying for Green Power, sensors for indoor air monitoring, lighting sensors, thermal controls, or individual lighting controls. "Problems arise when there are unrealistic expectations and a lack of education with regards to the certification process on the part of the various parties to a project"[33].

Architects should also clearly distinguish "building performance" from "building certification", and the limitations of each. Some owners may wish to incorporate sustainable measures into the project without seeking any green building certification, while others may wish to pursue certification, no matter what level the final performance may be.

All budget and post construction impacts, such as building operations and maintenance, should be discussed with the Owner. The architect must clarify "how those building systems are intended to be operated… and explain the impact on building use and occupancy"[34]. Owners must be clear about every area of the project that will be impacted and how to make an informed decision when balancing overall cost, schedule and the quality of the project.

4.3 Lack of Qualified Professionals

Accepting a green project without having qualified professionals who truly understand sustainable design methodologies may expose the firm to unnecessary liability. Architectural firms need to spend time training their architects in green design approaches and hire others who already have this kind of experience. If it is not possible for a firm to acquire or develop the applicable expertise, then they should consider not taking the project or hiring a sustainable design consultant to oversee and provide proper guidance in green design throughout the project design, construction and certification.

4.4 Marketing and Performance Promises

"Misleading or overstated claims of unverifiable benefits or performance may lead to claims of misrepresentation or fraud in the inducement from an end user who materially relies on such statements"[35]. Architects should refrain from making promises about the level of certification a green building will achieve; the amount of money in energy, electricity or water Owner will save, or a higher quality of indoor air that boosts employee productivity. These are objectives of green buildings, but systems may need to be adjusted for green buildings to perform as planned. Marketing materials could also "give rise to implied warranties or potential claims of negligent misrepresentation when the project fails to satisfy expectations created by those materials"[36].

4.5 Performance and LEED Certification Guarantees

Architect should refrain from adding contractual provisions such as warranties, guarantees, and assurances that a specific sustainable objective or a certain level of LEED certification will be achieved. When an architect agrees to "warrant" or "guarantee" a service, he may be unintentionally assuming a risk not covered under his professional liability insurance. Errors and Omissions (E&O) professional liability policies "typically excludes coverage for express warranties and guaranties"[37] and liability assumed under contract other than that which would be imposed in the absence of the contract. Instead, architects should consider adding affirmative acknowledgement language such as "the Architect does not warrant or guarantee that the Project will be granted LEED Certification by the GBCI"[38].

Green building certification is handled by a third party and relies on that organization's review and approval of project compliance with its requirements. On LEED projects, upon project documentation submitted online, a LEED review team will review all documentation provided. Some credits will be anticipated, some credits may require clarifications in order to be awarded, and other credits may be denied. Even though there are clear requirements on how to achieve LEED credits, some architects or engineers may interpret those credits in a different manner than LEED reviewers. As a result, certification may not be awarded or may be awarded at a lower level than expected. Therefore, the award of such certification is out of architects' control.

4.6 Loss of Tax Breaks or Other Market Incentives for Owners

Incentives can potentially become a source for claims. Architects should consider adding contract language addressing tax credits, such as: "If the Owner's program includes goals for qualifying for energy related tax credits, deductions, incentives, etc., the Owner recognizes that qualifying for such goals is subject to certification or decisions by third parties over whom the Architect has no control. Therefore, the parties agree that the Architect shall use reasonable care in its design to achieve such goals but makes no warranty or guarantee regarding qualification"[39].

4.7 LEED Submittal Templates

Information is uploaded into LEED online system through form templates that architects, and other team members, have to fill out and submit "complete" implying that all requirements for that credit have been satisfied. So, it could be interpreted that the architect completing a specific credit is attesting accuracy of certain green components or systems, which would not be covered under his E&O policy. Architects should make all parties agree in writing that "the architect's signature on a LEED submittal template is solely for the satisfaction of the LEED rating system and does not constitute any warranty or guarantee on behalf of the signatory"[40].

4.8 Commissioning Agent

In green buildings, the commissioning agent plays an important role as a quality assurance professional. He can prevent "a good design [from] being destroyed by poor installation…and assist in the development of the O&M manuals for the building management, as well as the training of the maintenance staff"[41].

4.9 Indoor Air Quality Issues

Improving indoor air quality of buildings to protect the health of occupants is one of the main objectives of green buildings. However, systems need to be properly commissioned, operated and maintained by the Owner, in order to perform as designed. Architects should require that owners hire a commissioning agent and "ensure that the building's management staff are properly trained to operate and maintain the building"[42].

4.10 New and Untested Products and Materials

The rapidly growing green building market is increasing demand for new materials to maximize building performance and green certification points. Because of such demand, new materials are sometimes being used without proper analysis of their efficacy and long term performance. This can be dangerous to architects because "most building materials are subjected to the Uniform Commercial Code's four-year limitation on product liability actions"[43] while architects' statute of limitation usually runs from six to ten years.

To limit liability arising out of material selection, architects should discuss untested products with the owner and explain any possible impacts on the project, including that product failure can lead to project failure in achieving a desired sustainable certification or performance outcome. Language should be added to the contract addressing the issue of risks of new materials to protect architects from claims, such as "the Owner will render a decision [about untested materials, and] … architect shall be permitted to rely on the manufacturers' or suppliers' representations and shall not be responsible for any failure of the Project to achieve the Sustainable Objective as a result of the use of such materials or equipment"[44]. After disclosing to the owner which materials are new and untested, architects should "obtain a sign-off from the owner acknowledging this fact or obtain a waiver of liability for the use of the new product"[45].

Finally, architects can "allocate resources to evaluate new materials and technologies" or hire independent laboratories to test and evaluate material performance[46]. Since testing is usually paid by the Owner, he should be aware of these additional costs.

4.11 Design Changes

Design changes during construction may have a profound impact on green buildings, since they utilize interdependent systems and materials that are affected by the performance of each system and their relationships to one another. For example, a simple change in a glass type may affect energy performance and lighting calculations. This "simple" change may cost several LEED points, and could even endanger LEED Certification. Architects should be careful regarding design changes, analyze reasonably foreseeable impacts in LEED certification that those changes may cause, and inform the owner, who may prefer a different glass, but not at the cost of the LEED certification. In addition, "a careful architect should require that the Owner contractually assume the risk of a lower level of certification – or loss certification – when changes are made"[47].

4.12 Specifications

Instead of promising a certain level of certification in the contract, "specifications can provide that certain building components shall be used such that the use of those components will satisfy the requirements for that certification level"[48]. Before listing new materials and products in the specifications, the availability of delivery to certain localities should be confirmed in order to avoid project delays and change orders that could adversely affect the achievement of certain LEED credits. In addition to Product Data and Shop Drawing submittals, LEED submittal requirements should be added to the specifications, so that contractors, subcontractors and suppliers provide such data continuously during the course of construction. Manufacturers' information stating LEED requirements compliance should be compiled by the project team and uploaded with LEED template forms to prove credit compliance. If project teams wait until project closeout, collecting this information could be difficult, thereby jeopardizing available credits. Information from manufacturers' data sheets are crucial to credit compliance, including recycled content of materials, location of product harvest and manufacture, VOC content of paints and adhesives, and location of construction waste disposal[49]. Architects should also consider including contract language stipulating that Certificates of Payment will only be authorized after receipt of LEED product information needed for project certification.

4.13 Contracts

Many issues arise out of misunderstandings about responsibilities which could be mitigated by utilizing precise contract language. The contracting parties should clearly define and address in their contract: scope of work, "green" terminology, building performance expectations, certification expectations, and the allocation of risks, especially for new untested materials[50]. The contract should also delineate responsibility for compliance with green building requirements, responsibility for being the project administrator for LEED certification (or other green certification program), risk and consequences for failure to achieve certification, and project end date[51]; tax credits, timeline and documentation requirements, liquidated damages, and tenant's benefits and obligations[52]. The contracting parties need to "become familiar with the incentives available in the locality… [and] need to be aware of local building requirements and the mandatory compliance with Green Building standards they can impose"[53].

Architect "shall discuss with the Owner alternative approaches to design and construction of the Project, including the feasibility of incorporating environmentally responsible design approaches"[54]. Architects should keep written records of these discussions with the Owner, including Owners' decisions regarding whether to apply environmentally friendly design and construction methods to the project. It is important to maintain written records because since contractual duties may include a "discussion" regarding green design, or "consideration" of green alternatives, and failure to comply with these duties may constitute a breach of contract[55].

4.14 Substantial Completion

The date of Substantial Completion is when the work is "sufficiently complete in accordance with the contract documents so that the owner can occupy or utilize the work for its intended use"[56]. This date will be affected by the flush-out requirement on LEED credit IAQ 3.2[57]. Therefore, architects need to be aware of and inform the Owner about this limitation. Certification will be awarded after construction has ended and project has been occupied by the Owner, frequently several months thereafter. This delay applies especially to projects pursuing credits such as Measurement and Verification[58] and Enhanced Commissioning[59], where building will be assessed for its performance to comply with LEED credits after occupancy.

4.15 Consequential Damages

The agreement between owner and contractor, AIA A201-2007 General Conditions of the Contract for Construction, defines consequential damage as "damages incurred by the owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the service of such persons"[60]. Since the agreement between Owner and Architect, AIA B101-2007, does not provide a definition, "the management of this risk should be contractually accomplished through a mutual consequential damage disclaimer or waiver provision"[61] in order to mitigate these unclear or unknown risks related to green buildings.

Consequential damages can be applicable under common law and may include loss of profits or underlying asset value, failure to qualify for a financial incentive or tax credits, failure to achieve certification, loss in worker productivity, or even lawsuit from tenants who leased spaces under green building promises[62]. Consequential damages "are not the direct byproduct of one party's breach, but rather those that 'flow' from the breach"[63]. However, in some cases it could be difficult to allocate liability for consequential damages in a green building case because more than one party could be responsible for failure to achieve a certain goal, and certain allegations such as loss in worker productivity could be difficult to prove. A waiver of consequential damages should be required in any design professional services prime contract, regardless if it includes "green design" duties or not.

4.16 Limiting Liability

Architects should include a provision limiting the maximum amount of damages owed if a claim arises. This amount can be the "available limits of its professional liability insurance policy" or "the extent of the design professional's fee"[64]. Limitations of liability may be enforceable (depending upon applicable law), but should always be clearly identified and set forth so that there is no ambiguity as to the intent of the parties.

4.17 Insurance Coverage

E&O policies cover claims related to bodily injury, physical damage to property, and claims for economic loss. Therefore, services rendered under AIA B214-2004 may not be covered under these policies, exposing architects to additional uninsured risks when providing LEED Certification. Architects should always confirm with their insurance carrier if these additional services are covered under their policies or consider adding a clause to the AIA contracts limiting "the amount of damages recoverable from the architect to the amount of compensation paid to the architect for services rendered"[65]. Coverage for failure to achieve LEED certification should also be confirmed. This issue is very important because many jurisdictions are adopting green standards and certification as a requirement, so failure to achieve certification might constitute a breach of contract and the architect could be liable to the owner[66]. It is unclear if architects who are only providing certification consulting services are covered by insurance if a project fails to achieve certification[67].

Basically, parties should seek to obtain green building related coverage wherever available. "As the green building market develops, insurers are continuing to introduce new products and it appears that appropriate insurance protection will become increasingly available on the commercial market"[68].

5.0 LEGAL CASES

The first litigation case involving green buildings, *Shaw Development v. Southern Builders*[69], related to the loss of a green building tax credit of US $635,000 on a $7.5 million project. The condominium project lost the tax credit because the Contractor failed to achieve the required LEED certification level and finished the project nine months later than scheduled, disqualifying the Owner from receiving the tax credit. This case was settled, preventing the Court from establishing a precedent.

Recently, in *Bain v. Vertex Architects,* the home owner filed a lawsuit against the architect for failing to achieve LEED certification[70]. This case has not been resolved yet.

In *Gidumal v. Site 16/17 Development,* condo owners of the Riverhouse condominium development in New York brought a lawsuit against the developer, alleging fraud and misrepresentation since, among other claims, the building's heating system did not perform as promised[71]. This case has not been resolved yet.

6.0 CONTRACT RESOURCES FOR A GREEN PROJECT

AIA B101-2007 "does little to assist in allocating the liability risks"[72] and "did not solve the innovative evolutions within the design and construction industry"[73]. Therefore, the AIA recently developed AIA 503 – 2011, Guide for Sustainable Projects, which provides extensive model contract language that can be added to other construction contracts. It is a valuable resource that provides a thorough overview of the green building process. This document also defines Sustainable Objectives, Sustainable Measure, Sustainability Plan, Sustainability Certification, Documentation for Certification and Certifying Authority.

AIA B214-2004 is a standard contract for architect's services performing LEED certification. It defines the scope of work during all phases of design and construction. However, it does not address failure to achieve LEED certification, so contracting parties should add language to their contract "specifying consequences for the failure to achieve LEED Certification"[74].

ConsensusDOCS is a series of contracts also widely used in the construction industry. One contract is the 310 Green Building Addendum, which address participants' roles and responsibilities, scope of work, risks, liabilities, and defines a Green Building Facilitator, who will be in charge of green building certification, including coordination of all documents for submission.

Many law firms have developed their own analysis of architects' liability risks and continuously offer ideas on how to mitigate those risks through conferences and private consultations. For example, the article "Green and Sustainable Design Part II: Contractual and Risk Management Recommendations for Design Professionals to Manage Risk and Minimize the Availability of Professional Liability Insurance"[75] provides samples of contract language, such as waiver of consequential damages, waiver of subrogation, limitation of liability, and other aspects addressing different legal issues.

7.0 CONCLUSION

In this rapidly changing market for green buildings, architects may be exposed to additional risks and legal liability. Before agreeing to participate in a green building project, they must gain a clear understanding about green building strategies and approaches, and even consider partnering with more experienced professionals in that field when appropriate.

Although most risks analyzed are currently hypothetical and Courts have yet to provide precedent for green building claims, architects should be diligent, analyze reasonably foreseeable potential risks, and take reasonable precautions to minimize exposure to losses.

REFERENCES

[1] United States Environmental Protection Agency. "What is green building?", Retrieved on 04/2012 from http://www.epa.gov/greenbuilding/pubs/faqs.htm#1.

[2] United States Green Building Council, (2009). "Green Building by the Numbers", Green Building Fact Sheet.

[3] Epstein, P. R., Mills, E., eds., (2005). "Climate Change Futures – Health, Ecological and Economic Dimensions", The Center for Health and the Global Environment, Harvard Medical School.

[4] Bowers, K, and Cohen, L., (2009). "The Green Building Revolution: Addressing and Managing Legal Risks and Liabilities", Environmental Law & Policy Clinic, Harvard Law School, March 10.

[5] United States Green Building Council. "What LEED is", Retrieved on 04/12 from http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1988.

[6] Bernstein, H. M., (2012). "The Green Outlook 2011: Green Trends Driving Growth through 2015", Outlook 2011 McGraw Hill Construction Executive Conference.

[7] Cusano, R. S., (2009). "When 'Green' Turns To 'Red' and LEEDs to a Summons and Complaint: Potential Liability on Green Projects – Allocating Risk and Avoiding Liability Pitfalls", *Proceedings of the American Bar Association, Forum on the Construction Industry.* [Refer to this article for a list of federal agencies and states that have adopted green building requirements.]

[8] U.S. Green Building Council, “A Green Economy is a Growth Economy: How Green Building Supports Job Creation, Workforce Transformation and Economic Recovery”, Fact Sheet on Green Jobs.

[9] AIA B101, Article 3 Scope of Architect’s Basic Services (2007 ed.).

[10] AIA B101, § 3.2.3 (2007 ed.).

[11] AIA Document D503 – 2011, Guide for Sustainable Projects, including Agreement Amendments and Supplementary Conditions.

[12] Prum, D. A., and Del Percio, S., (2009). “Green Building Claims: What Theories will a Plaintiff Pursue, Who has Exposure, and a Proposal for Risk Mitigation”, *Real Estate Law Journal,* Vol. 37, No. 4, pp. 243-259.

[13] AIA Document D503 – 2011, Guide for Sustainable Projects, including Agreement Amendments and Supplementary Conditions.

[14] Hatem, D., (2010). “Green and Sustainable Design Part I: Professional Liability Risk and Insurability Issues for Design Professionals”, *Design and Construction Management Professional Reporter.*

[15] AIA B101, § 2.2 (2007 ed.).

[16] Ericksen, D. A., (2010). “A Sustainable Standard of Care? Managing Evolving & Innovative Products, Processes & Performance Standards in Design Delivery”, AIA Trust White Papers.

[17] United States Green Building Council. “LEED BD+C”, Retrieved on 4/2012 from http://www.usgbc.org/DisplayPage.aspx?CMSPageID=2192.

[18] Prum, D. A., and Del Percio, S., (2009). “Green Building Claims: What Theories will a Plaintiff Pursue, Who has Exposure, and a Proposal for Risk Mitigation”, *Real Estate Law Journal,* Vol. 37, No. 4, pp. 243-259.

[19] Hatem, D., (2010). “Green and Sustainable Design Part I: Professional Liability Risk and Insurability Issues for Design Professionals”, *Design and Construction Management Professional Reporter.*

[20] Prum, D. A., (2012). “Green Building Liability: Considering the Applicable Standard of Care and Strategies for Establishing a Different Level by Agreement”, *Hastings Business Law Journal,* Vol. 8, No. 33, pp. 1.

[21] Ericksen, D. A., (2010). “A Sustainable Standard of Care? Managing Evolving & Innovative Products, Processes & Performance Standards in Design Delivery”, AIA Trust White Papers.

[22] Waggoner, T. F., (2005). “Green Buildings: Potential Pitfalls for Design Professionals.” *Proceedings of Schinnerer’s 44th Annual Meeting of Invited Attorneys.*

[23] Bowers, K, and Cohen, L., (2009). “The Green Building Revolution: Addressing and Managing Legal Risks and Liabilities”, Environmental Law & Policy Clinic, Harvard Law School, March 10.

[24] Bowers, K, and Cohen, L., (2009). “The Green Building Revolution: Addressing and Managing Legal Risks and Liabilities”, Environmental Law & Policy Clinic, Harvard Law School, March 10. [Refer to this article for a thorough legal analysis of basis for liability, which is out of scope of this article.]

[25] U.S. Green Building Council (2009). “The Legal Risk in ’Building Green’: New Wine in Old Bottles?”, USGBC Panel Discussion White Paper.

[26] Hatem, D., (2010). “Green and Sustainable Design Part I: Professional Liability Risk and Insurability Issues for Design Professionals”, *Design and Construction Management Professional Reporter.*

[27] Metz, T. R., and Cheatham, C. W. (2008). “As Green Building Moves Forward, Claims and Disputes Will Follow”, *Construction Law and Public Contracts,* Vol. 57, pp. 56-59.

[28] Hatem, D., (2010). “Green and Sustainable Design Part I: Professional Liability Risk and Insurability Issues for Design Professionals”, *Design and Construction Management Professional Reporter.*

[29] Bowers, K, and Cohen, L., (2009). “The Green Building Revolution: Addressing and Managing Legal Risks and Liabilities”, Environmental Law & Policy Clinic, Harvard Law School, March 10.

[30] Waggoner, T. F., (2005). “Green Buildings: Potential Pitfalls for Design Professionals”, *Proceedings of Schinnerer’s 44th Annual Meeting of Invited Attorneys.*

[31] Bowers, K, and Cohen, L., (2009). “The Green Building Revolution: Addressing and Managing Legal Risks and Liabilities”, Environmental Law & Policy Clinic, Harvard Law School, March 10.

[32] Hatem, D., (2010). “Green and Sustainable Design Part I: Professional Liability Risk and Insurability Issues for Design Professionals”, *Design and Construction Management Professional Reporter.*

[33] U.S. Green Building Council (2009). “The Legal Risk in ’Building Green’: New Wine in Old Bottles?”, USGBC Panel Discussion White Paper.

[34] AIA Document D503 – 2011, Guide for Sustainable Projects, including Agreement Amendments and Supplementary Conditions, 12.

[35] Anderson, M. K., Bidgood, J. K., and Heady, E. J., (2010). “Hidden Legal Risks of Green Building”, *Florida Bar Journal,* Vol. 84, No. 3, pp. 35.

[36] Anderson, M. K., Bidgood, J. K., and Heady, E. J., (2010). “Hidden Legal Risks of Green Building”, *Florida Bar Journal,* Vol. 84, No. 3, pp. 35.

[37] Kelleher, T., (2009). *Smith, Currie & Hancock’s Common Sense Construction Law,* Hoboken, NJ: John Wiley&Sons.

[38] AIA Document D503 – 2011, Guide for Sustainable Projects, including Agreement Amendments and Supplementary Conditions.

[39] Hatem, D., (2010). “Green and Sustainable Design Part II: Contractual and Risk Management Recommendations for Design Professionals to Manage Risk and Maximize the Availability of Professional Liability Insurance”, *Design and Construction Management Professional Reporter.*

[40] Anderson, M. K., Bidgood, J. K., and Heady, E. J., (2010). “Hidden Legal Risks of Green Building”, *Florida Bar Journal,* Vol. 84, No. 3, pp. 35.

[41] Waggoner, T. F., (2005). “Green Buildings: Potential Pitfalls for Design Professionals”, *Proceedings of Schinnerer’s 44th Annual Meeting of Invited Attorneys.*

[42] Waggoner, T. F., (2005). “Green Buildings: Potential Pitfalls for Design Professionals”, *Proceedings of Schinnerer’s 44th Annual Meeting of Invited Attorneys.*

[43] Waggoner, T. F., (2005). “Green Buildings: Potential Pitfalls for Design Professionals”, *Proceedings of Schinnerer’s 44th Annual Meeting of Invited Attorneys.*

[44] AIA Document D503 – 2011, Guide for Sustainable Projects, including Agreement Amendments and Supplementary Conditions.

[45] Waggoner, T. F., (2005). “Green Buildings: Potential Pitfalls for Design Professionals”, *Proceedings of Schinnerer’s 44th Annual Meeting of Invited Attorneys.*

[46] Waggoner, T. F., (2005). “Green Buildings: Potential Pitfalls for Design Professionals”, *Proceedings of Schinnerer’s 44th Annual Meeting of Invited Attorneys.*

[47] Anderson, M. K., Bidgood, J. K., and Heady, E. J., (2010). “Hidden Legal Risks of Green Building”, *Florida Bar Journal,* Vol. 84, No. 3, pp. 35.

[48] Bowers, K, and Cohen, L., (2009). “The Green Building Revolution: Addressing and Managing Legal Risks and Liabilities”, Environmental Law & Policy Clinic, Harvard Law School, March 10.

[49] Anderson, M. K., Bidgood, J. K., and Heady, E. J., (2010). “Hidden Legal Risks of Green Building”, *Florida Bar Journal,* Vol. 84, No. 3, pp. 35.

[50] U.S. Green Building Council (2009). “The Legal Risk in ’Building Green’: New Wine in Old Bottles?”, USGBC Panel Discussion White Paper.

[51] Cusano, R. S., (2009). “When ‘Green’ Turns To ‘Red’ and LEEDs to a Summons and Complaint: Potential Liability on Green Projects – Allocating Risk and Avoiding Liability Pitfalls”, *Proceedings of the American Bar Association, Forum on the Construction Industry.*

[52] Bowers, K, and Cohen, L., (2009). “The Green Building Revolution: Addressing and Managing Legal Risks and Liabilities”, Environmental Law & Policy Clinic, Harvard Law School, March 10.

[53] Cusano, R. S., (2009). “When ‘Green’ Turns To ‘Red’ and LEEDs to a Summons and Complaint: Potential Liability on Green Projects – Allocating Risk and Avoiding Liability Pitfalls”, *Proceedings of the American Bar Association, Forum on the Construction Industry.*

[54] AIA B101, § 3.2.3 (2007 ed.).

[55] Anderson, M. K., Bidgood, J. K., and Heady, E. J., (2010). “Hidden Legal Risks of Green Building”, *Florida Bar Journal,* Vol. 84, No. 3, pp. 35.

[56] AIA A201, § 9.8.1 (2007 ed.).

[57] United States Green Building Council, (2009). "LEED Reference Guide for Green Building Design and Construction", Indoor Environmental Quality (IEQ) Credit 3.2 – Construction Indoor Air Quality Management Plan – Before Occupancy.

[58] United States Green Building Council, (2009). "LEED Reference Guide for Green Building Design and Construction", Energy and Atmosphere (EA) Credit 5.2 Measurement and Verification – Tenant Submetering.

[59] United States Green Building Council, (2009). "LEED Reference Guide for Green Building Design and Construction", Energy and Atmosphere (EA) Credit 3 Enhanced Commissioning.

[60] AIA A201, § 15.1.6 (2007 ed.).

[61] Hatem, D., (2010). "Green and Sustainable Design Part I: Professional Liability Risk and Insurability Issues for Design Professionals", *Design and Construction Management Professional Reporter.*

[62] Prum, D. A., and Del Percio, S., (2010). "Green Building Contracts: Considering the Roles of Consequential Damages & Limitation of Liability Provisions", *Loyola Consumer Law Review,* Vol. 23, No. 2, pp. 113-146.

[63] Prum, D. A., and Del Percio, S., (2010). "Green Building Contracts: Considering the Roles of Consequential Damages & Limitation of Liability Provisions", *Loyola Consumer Law Review,* Vol. 23, No. 2, pp. 113-146.

[64] Prum, D. A., and Del Percio, S., (2010). "Green Building Contracts: Considering the Roles of Consequential Damages & Limitation of Liability Provisions", *Loyola Consumer Law Review,* Vol. 23, No. 2, pp. 113-146.

[65] Anderson, M. K., Bidgood, J. K., and Heady, E. J., (2010). "Hidden Legal Risks of Green Building", *Florida Bar Journal,* Vol. 84, No. 3, pp. 35.

[66] Cusano, R. S., (2009). "When 'Green' Turns To 'Red' and LEEDs to a Summons and Complaint: Potential Liability on Green Projects – Allocating Risk and Avoiding Liability Pitfalls", *Proceedings of the American Bar Association, Forum on the Construction Industry.*

[67] Prum, D. A., and Del Percio, S., (2010). "Green Building Contracts: Considering the Roles of Consequential Damages & Limitation of Liability Provisions", *Loyola Consumer Law Review,* Vol. 23, No. 2, pp. 113-146.

[68] Bowers, K, and Cohen, L., (2009). "The Green Building Revolution: Addressing and Managing Legal Risks and Liabilities", Environmental Law & Policy Clinic, Harvard Law School, March 10.

[69] *Shaw Development v. Southern Builders,* No. 19-C-07-001405 (Somerset Cty. Cir. Ct. Md. 2007).

[70] Del Percio, S. (2011). "Bain v. Vertex Architects: Firm 'Failed to Diligently Pursue and Obtain LEED for Homes Certification from USGBC'", Retrieved on 4/2012 from http://www.greenrealestatelaw.com/2011/03/bain-v-vertex-architects-firm-failed-to-diligently-pursue-and-obtain-leed-for-homes-certification-from-usgbc.

[71] Del Percio, S. (2010). "Unit Owners File Suit Against LEED Gold-Hopeful Riverhouse in Battery Park City", Retrieved on 4/2012 from http://www.greenrealestatelaw.com/2010/05/unit-owners-file-suit-against-leed-gold-hopeful-riverhouse-in-battery-park-city/.

[72] Cusano, R. S., (2009). "When 'Green' Turns To 'Red' and LEEDs to a Summons and Complaint: Potential Liability on Green Projects – Allocating Risk and Avoiding Liability Pitfalls", *Proceedings of the American Bar Association, Forum on the Construction Industry.*

[73] Ericksen, D. A., (2010). "A Sustainable Standard of Care? Managing Evolving & Innovative Products, Processes & Performance Standards in Design Delivery", AIA Trust White Papers.

[74] Cusano, R. S., (2009). "When 'Green' Turns To 'Red' and LEEDs to a Summons and Complaint: Potential Liability on Green Projects – Allocating Risk and Avoiding Liability Pitfalls", *Proceedings of the American Bar Association, Forum on the Construction Industry.*

[75] Hatem, D., (2010). "Green and Sustainable Design Part II: Contractual and Risk Management Recommendations for Design Professionals to Manage and Maximize the Availability of Professional Liability Measure".

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04.
SIMULATION MODELING AS A METHOD FOR DETERMINING FACILITY SIZE OF AN EMERGENCY DEPARTMENT USING LEAN DESIGN PRINCIPLES

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ABSTRACT
This article outlines the use of a Lean design process, enabled by simulation modeling, to determine the appropriate size of an emergency department based on current patient volumes and projected patient volumes in 12 years. In its most recent year, the emergency department hosted 67,000 patient visits within 34 exam rooms. Projections estimate that almost 74,000 annual patient visits within 56 exam rooms will be needed in this emergency department in 12 years. This study began with a process map of the patient flow within each acuity level. Thereafter, a simulation model was built to mimic the patient flow in the design of the new emergency department. Patient wait times were the key metric to assess the efficacy of the facility design. The results of this study revealed that the planned facility size was bigger than necessary and rooms could be eliminated from the plan and design, thus providing savings in construction.

KEYWORDS: operations planning, process modeling, right-sizing, space requirements, modeling, simulation

1.0 INTRODUCTION
This article demonstrates the use of Lean process mapping and simulation modeling to calculate the recommended number of exam rooms by care intensity in an emergency department. A Lean system allows for an efficient response to fluctuating customer demands and requirements[1]. In healthcare, Lean is about shortening the time between the patient entering and leaving a care facility by eliminating all non-value added time, motion, and steps; it all leads to providing a quality healthcare system[2].

The research problem that this article addresses is how to optimize space requirements for an emergency department, while balancing relationship between the number of exam rooms and patients' wait times. It is possible to maintain the number of emergency department visits with very few exam rooms, but the patient wait time may increase significantly. Conversely, having many exam rooms and staff may result in short patient wait times, but very high costs to build and operate the facility. In addressing this problem, simulation modeling was used to assess patient flow, wait times, and analyze capacity[3]. The following sections describe the research methodology and results in detail.

2.0 METHODOLOGY

2.1 Data Collection
To complete the simulation modeling for the emergency department, the Perkins+Will team gathered data on current patient volumes, as well as projected future patient volumes for each acuity level. A five-level emergency department triage algorithm provides clinically relevant stratification of patients based on patient acuity and resource needs. The purpose of triage is to prioritize incoming patients and to identify patients that cannot wait. There has been a trend to standardize triage acuity scales that have 5 levels (e.g., 1-resuscitation, 2-emer-

gent, 3-urgent, 4-less urgent, 5-non-urgent)[4]. Additionally, length of stay data by acuity level and patient arrival pattern data was also obtained. Planned counts for exam rooms by traditional programming methods was provided based on input from the client. The critical care rooms were for the highest acuity patients such as Trauma, resuscitation and acute Myocardial Infarction, while the emergent rooms were designated for chest pain patients, stroke and abdominal pain. The Express Care rooms were for lower acuity conditions such as lacerations, and fractured extremities, while the Intake rooms were used for triage/assessment and in many cases as a "treat and street" area. Figure 1 provides an overview of sample data.

2.2 Tools and Techniques

The first step in developing the simulation model was to create a process map for the patient flow through the emergency department, by acuity level, as shown in Figure 2. Some of the acuity levels had patients that need to be lying down while others could remain upright or vertical.

As shown in Figure 3, this process flow also reflected the percentage of patients following each pathway through the process, and these percentages served as probabilities in the simulation model.

Fiscal Year 2011 Data	Fiscal Year 2024 Projections
Visits: 67,000	Visits: 74,000
Critical Care & Emergent Rooms: 28	Critical Care Rooms: 4
Express Care Rooms: 6	Emergent Rooms: 27
Total Exam Rooms: 34	Express Care Rooms: 20
	Intake Rooms: 5
	Total Exam Rooms: 56

Figure 1: Sample data overview.

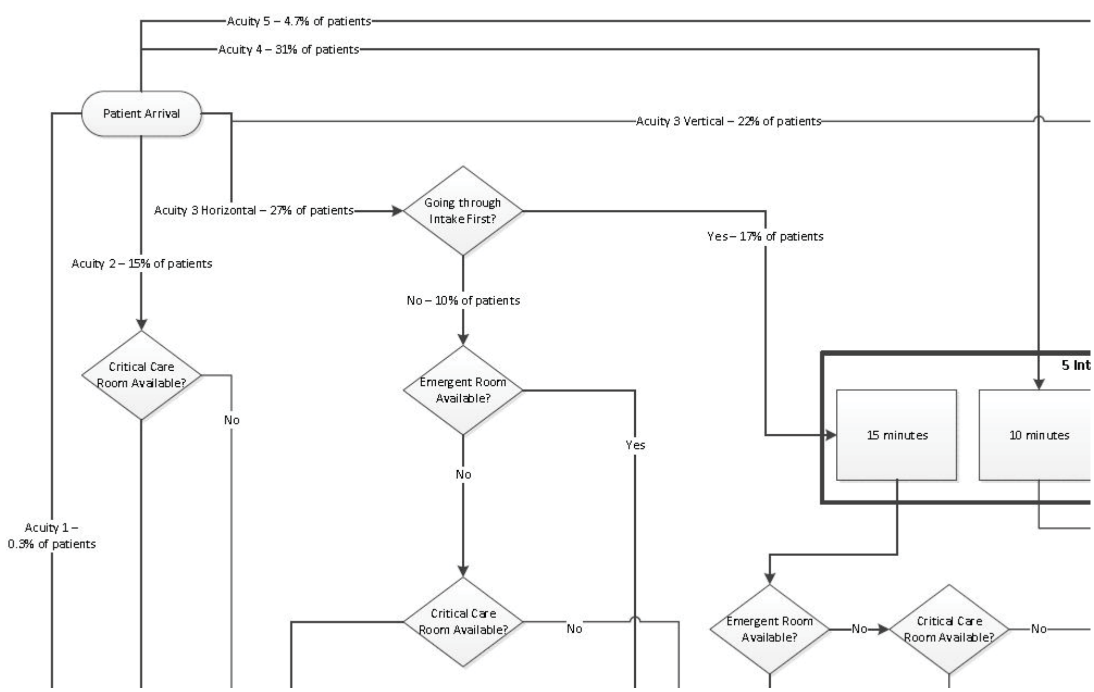

Figure 2: Patient flow process map.

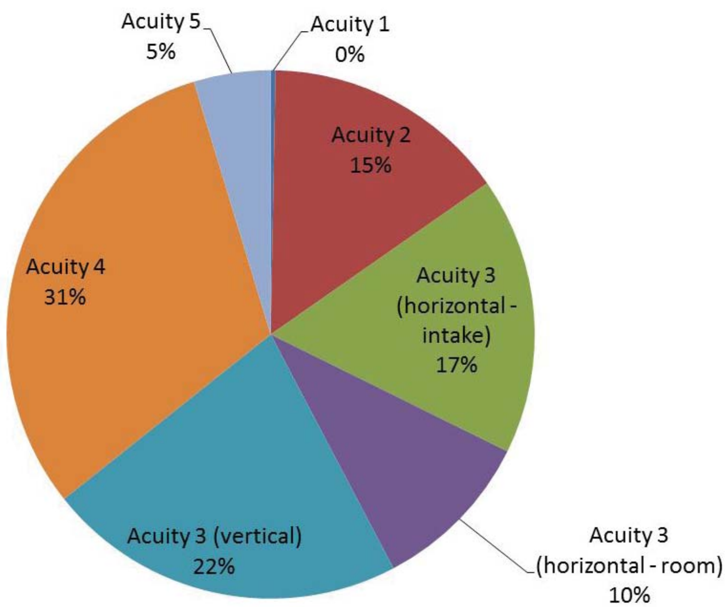

Figure 3: Percentage of emergency department patients by acuity level.

Additional calculations included the time involved with movement from one location to the next, based on the planned physical layout of the department.

Next, the team determined the variables that would best represent whether the design of the emergency department could accommodate the expected increase in patient visits. The team selected average patient wait time for a room by acuity level and the utilization percentage by room type as the variables for optimization in the model.

Observational studies were conducted to determine existing patient flow and processes. Process flow charts were developed to visualize the flow of patients through various areas of the clinic. These flow charts were overlaid with statistical analyses to determine the probability of patients flowing through each pathway.

Next, simulation models were built in ProModel's MedModel software[3]. The models simulate patient flow and provide statistics on the two chosen variables, which can be used to measure process efficiency. In this particular simulation, the levels of acuity play a major role in the placement of the patients. For the acuity level one patient, there can be no waiting time. These patients are at risk of death, and must be seen immediately, so they are placed in the critical care rooms. A breakdown of room requirements, their functional intent and their required adjacencies had been established within the space programming of the department. Certain acuities had specific rooms where patients would be placed first and if those areas were not open, patients could be seen in other areas or experience time in a waiting room. Some may go first to seek an emergent bed while others may first seek an express care room. The models can respond to "if, then" logic. For example, if an acuity three vertical patient arrives, the first choice is to place the patient in an intake room. However, if an intake room is not available, then the patient will be placed in an express care room. If an express care room is not available, then the patient will be placed in an emergent room. If none of these room types are available, the patient will wait in the waiting area. The simulation model handles all of this logic, and provides statistics based on the patient flow.

The treatment room projections assumed that a room would be available 99% of the time. This will be well noted in the average waiting time results for a room.

2.3 Simulation Results

Four different scenarios were simulated, which are described in more detail in this section.

Scenario One

The first simulated scenario considered the projected patient volumes for 12 years from present (see Table 1).

With wait times less than one minute, the increased volumes expected in 12 years are manageable with the environment as designed. Average wait times less than one minute may actually represent excess capacity, or more exam rooms than necessary.

Scenario Two

The team questioned the busy times in the emergency department. While the wait times for all acuity levels are, on average, less than a minute, are there times when wait times would drastically increase? With this question in mind, the team explored patient wait times during peak periods, from 16:00 to 20:00 each day. The simulation model was rerun, and statistics were reviewed for the peak times. The results are shown in Table 2.

While several of the wait times increased, it is important to note that none of them are above one minute. Less than one minute wait in the emergency department during peak times is considered very acceptable to patients, and likely represent excess capacity.

Scenario Three

Next, the team questioned what would happen if the emergency department volumes were increased much further than the facility projected. The facility projected 74,000 visits per year in 12 years. However, if the projection was incorrect, and 90,000 visits were seen in one year, what would happen? Could the emergency department handle this volume? The model was re-run and wait times were reviewed.

Results are shown in Table 3. Again, wait times increased in this scenario, but all times were still less than one minute. This provided great confidence that the emergency department could handle even higher volume levels.

Next, the team questioned whether the number of planned rooms was too great. Statistics by room type for 90,000 visits were reviewed and are shown in Table 4.

The statistics indicate that room utilization is well within reasonable expectation of performance. In general, room utilization in excess of 80 percent is concerning, as there is time that each room must be out of commission for maintenance, as well as the time to clean the room between patients.

Table 1: Scenario 1 based on 12 year volume projection.

Patient Acuity	Length of Stay (minutes)	% of Total Emergency Patient Visits	Average Time Waiting for a Room (seconds)
1	160	0.3	2.3
2	220	15	5.3
3	220	49	2.3
4	90	31	4.5
5	30	4.7	7.1

Table 2: Scenario 2 based on patient volume during peak times.

Patient Acuity	Length of Stay (minutes)	% of Total Emergency Patient Visits	Average Time Waiting for a Room (seconds)
1	160	0.3	1.6
2	220	15	10.2
3	220	49	3.1
4	90	31	7.1
5	30	4.7	5.2

Table 3: Scenario 3 based on wait times and volume of 90,000 patient visits per year.

Patient Acuity	Length of Stay (minutes)	% of Total Emergency Patient Visits	Average Time Waiting for a Room (seconds)
1	160	0.3	44.3
2	220	15	46.6
3	220	49	4.6
4	90	31	15.1
5	30	4.7	14.9

Table 4: Scenario 3 based on number of rooms and volume of 90,000 patients.

Type of Room	Number of Rooms	Turn-Around-Time (minutes)	Utilization Percentage
Critical Care	4	160 - 220	37
Emergent	27	135 - 220	55
Express Care	20	80 - 220	48
Intake	5	10 - 30	35

Table 5: Scenario 4 based on 10 fewer rooms with volume of 90,000 patients.

Patient Acuity	Length of Stay (minutes)	% of Total Emergency Patient Visits	Average Time Waiting for a Room (seconds)
1	160	0.3	76.5
2	220	15	71.6
3	220	49	2.2
4	90	31	17.3
5	30	4.7	7.7

Table 6: Scenario 4 (effect of 10 fewer rooms on turn-around-times and utilization).

Type of Room	Number of Rooms	Turn-Around-Time (minutes)	Utilization Percentage
Critical Care	4	160 - 220	33
Emergent	17	135 - 220	50
Express Care	20	80 - 220	56
Intake	5	10 - 30	29

Scenario Four

After confirming that the planned size of the emergency department could accommodate many more patients than projected, the team altered the simulation model to review results with 10 fewer emergent rooms. The patient volumes were kept at 90,000 per year, even though estimates were for a maximum of 74,000 visits per year. The results are shown in Table 5. The results showed an increase in wait time for patients, above one minute, but none exceeded two minutes. Room utilization slightly increased for emergent care rooms and decreased for all other room types, as shown in Table 6. This revealed that the planned facility size was bigger than necessary and rooms could be eliminated from the plan and design, thus providing savings in construction and maintenance costs.

3.0 CONCLUSION

Simulation is a great tool to test facility plans and space programs prior to design and construction of new or renovated facilities. Simulation studies can be used in the Lean design process to understand space requirements during the programming stage. Results can be predicted, and facilities may be right-sized to achieve the desired results. This particular facility chose to keep the room numbers as previously planned and repurpose some of the rooms.

Since developing the simulation model for this Health System's emergency department, the Perkins+Will Healthcare Planning + Strategies team plans to further explore uses of simulation modeling as a lean tool to support healthcare facility planning and design.

REFERENCES

[1] Black, J., and Miller, D. (2008). *Toyota Way to Healthcare Excellence: Increase Efficiency and Improve Quality with Lean,* Health Administration Press.

[2] The Global Association of Productivity and Efficiency Professionals, Institute of Industrial Engineers, 2012.

[3] Promodel Corporation, (2003). MedModel User Guide, Healthcare Simulation Software, version 6.

[4] Gilboy, N., Tanabe, P., Travers, D., and Rosenau, A. M. (2011). Emergency Severity Index: A Triage Tool for Emergency Department Care.

05.
THE IMPACT OF AN OPERATIONAL PROCESS ON SPACE:
Improving the Efficiency of Patient Wait Times

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ABSTRACT
A large community hospital with over 100,000 emergency visits annually was challenged with reducing their patient waiting times, and decided to make some critical changes to their process in order to care for their patients. The hospital was certain that the lack of space was the primary cause of the problem, as all exam rooms and the waiting areas were occupied during peak times. This study was conducted to understand the relationships between current operational practices, patient volumes and flow of patients through the different areas of the emergency department. The team first approached the study by understanding the operational processes in the emergency department. Through the use of Lean design principles, observational study, and other methods such as data analysis and operational modeling, the research team identified opportunities that would improve operations and flow with minimal construction costs.

KEYWORDS: emergency department, process improvement, fast track, operations modeling, Lean

1.0 INTRODUCTION
This study focused on an emergency department (ED) of a large community hospital. The emergency department operates as four entities: Children's Emergency Center (CEC), Fast Track (FT), Main, and Observation. The CEC cares for all pediatric patients, while the other three areas care for adults. FT is dedicated to simple medical issues, Main is for complex medical issues, and Observation is for patients who need to be observed further, but do not need to be admitted to the hospital.

FT, with the shortest turn-around-time for patients, at less than two hours, was targeted for improvement. The hypothesis was that if more patients could be seen in the FT area, additional space would be available in the other areas, patient turn-around-times would decrease, and patient and staff satisfaction would improve.

The researchers utilized different methods to understand the operations of the emergency department, assess the primary causes of these challenges, analyze several options, and then recommend potential solutions. Many of these methods have their origins in Lean design principles. While Lean processes are not new (it started with Henry Ford in 1913), it has only recently taken hold in healthcare and service industries[1]. The utilized research methods included:

- *Observational Study* – Observational studies allow the researchers to see the workplace in action, at the front-line. For this study, observational study focused on identifying wastes in the current operation of the emergency department, as well as understanding the culture of the existing work environment.
- *Process Mapping* – Hospital staff collaborated with the facilitators to map out the current workflow for processing patients in the emergency department. Each step was mapped, and opportunities for improvement were placed on a map as yellow starbursts. Then, a future state process map was developed to depict the desired method for operating in the FT area.

- *Data Analysis* – Operational data, such as turn-around-times, number of visits by service area, and number of visits by intensity of services rendered, were analyzed. The analysis revealed potential opportunities for improvement.
- *Operational Modeling* – After potential changes were identified through data analysis, a simple operational model was completed to estimate the impact of the changes on the workflow that would improve their original concern of patient flow.

2.0 METHODOLOGY

2.1 Observational Study

The research team toured the existing workspace, learning about the current work processes and patient flow processes. The team was able to visualize the space and how it was utilized by its occupants. As "outsiders", the team quickly identified opportunities to improve the use of the existing space. For example, FT was operating out of a small, short hallway with only five small rooms (that were each unique) and three recliners. This small space facilitated collegiality amongst the staff as well as close communication. Cultural aspects were identified as important considerations for process mapping, as well as understating how this space functions.

Furthermore, the team identified the eight wastes outlined by Lean principles, which include: overproduction, defects, inventory, over-processing, transportation, waiting, motion, and unutilized people[2]. Table 1 shows the examples that were recorded during the observational study.

Table 1: The eight wastes.

Waste	Description	Example from Observational Study
Overproduction	Processing too soon or too much	Greeters prepared multiple clipboards with forms in advance of a patient's arrival
Defects	Errors, mistakes, rework	Mis-keyed information in the registration system, medication errors
Inventory	Holding more inventory than required	Stock-piles of supplies and equipment in some areas while others were short of the same supplies and equipment (for example, wheelchairs)
Over-processing	Processing more than required (overly-complex process)	Patients repeat the same information multiple times to various workers
Transportation	Moving items more than required (wasting energy)	Many hand-offs of the patient and his/her information amongst various workers
Waiting	Employees or customers waiting	Employees at the Triage area waiting to see a patient while Registration registered the patient; patients waiting in the waiting area and in exam rooms
Motion	Moving people more than required	Workers moving from exam rooms to the waiting area, back to exam rooms; workers hunting for supplies and equipment
Unutilized People	Not leveraging workers to their fullest potential	Having nurses clean exam rooms between patients

The team utilized a floor plan of the existing space to outline how all areas are currently being used, and to note any barriers created by the existing space. For example, the FT area lacked visibility to the waiting area, causing disconnect from lack of information about the number of patients waiting, and the condition of those patients.

2.2 Process Mapping

Next, the research team met with several members of the department to understand and map the current workflow. A technique known as "swim lane format" was utilized to map the flow of patients[3]. In this format, roles or locations are represented graphically in lanes across the page, with steps completed by that role or in that location displayed in that row. Swim lanes are a way to visualize how much activity is completed by each role or in each location. Additionally, challenges currently encountered in the process were highlighted with yellow bursts. A sample of the process maps developed is shown in Figure 1.

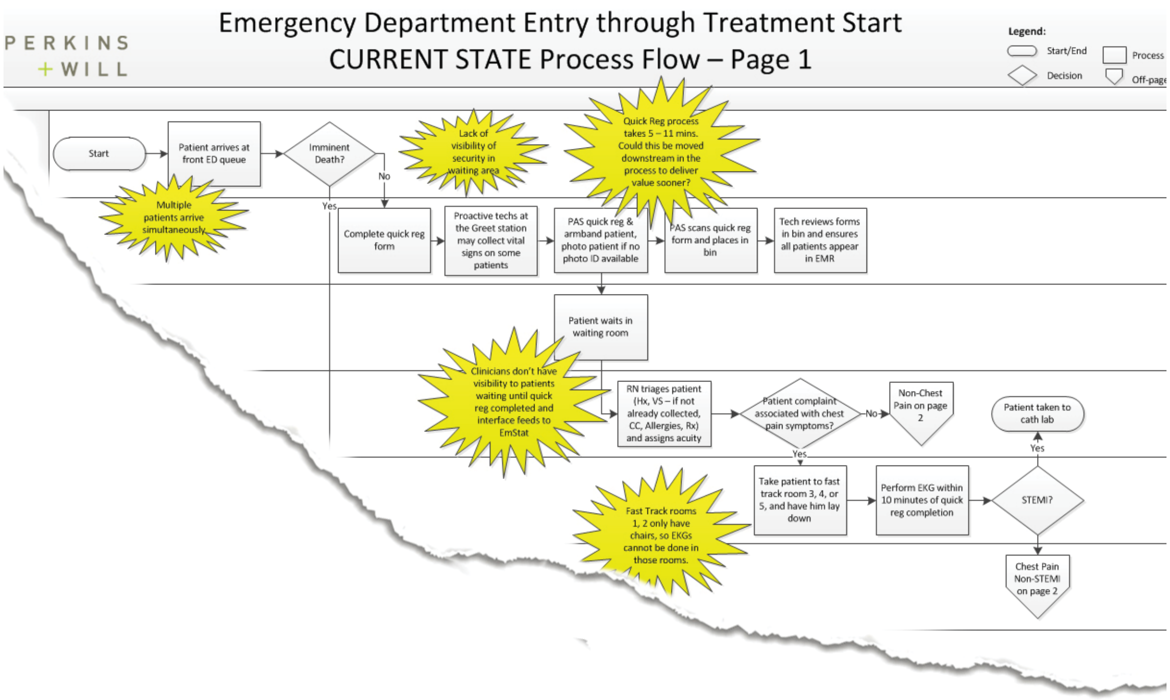

Figure 1: Process flow map of the current state in emergency department.

Next, the team evaluated a process where many more patients could be cared for in FT. This process was outlined as the "future state" and represented how the department wanted to operate. When envisioning the future state, the team utilized some of the earlier referenced Lean principles, such as the elimination of waste, delivering more value to the customer in less time, and 5S for organization of spaces. The Lean tool, 5S, is about organizing spaces, and includes five steps: sort, set in order, shine, standardize, and sustain. The future state was meant to reflect an ideal situation, and it was documented as process maps, assuming space and staffing would not be an issue. Here again, swim lane maps were utilized. The yellow bursts in the future state map represented opportunities for further improvement. For example, one burst highlighted the opportunity to standardize processes for making clinical decisions. A sample of the future state process is shown in Figure 2.

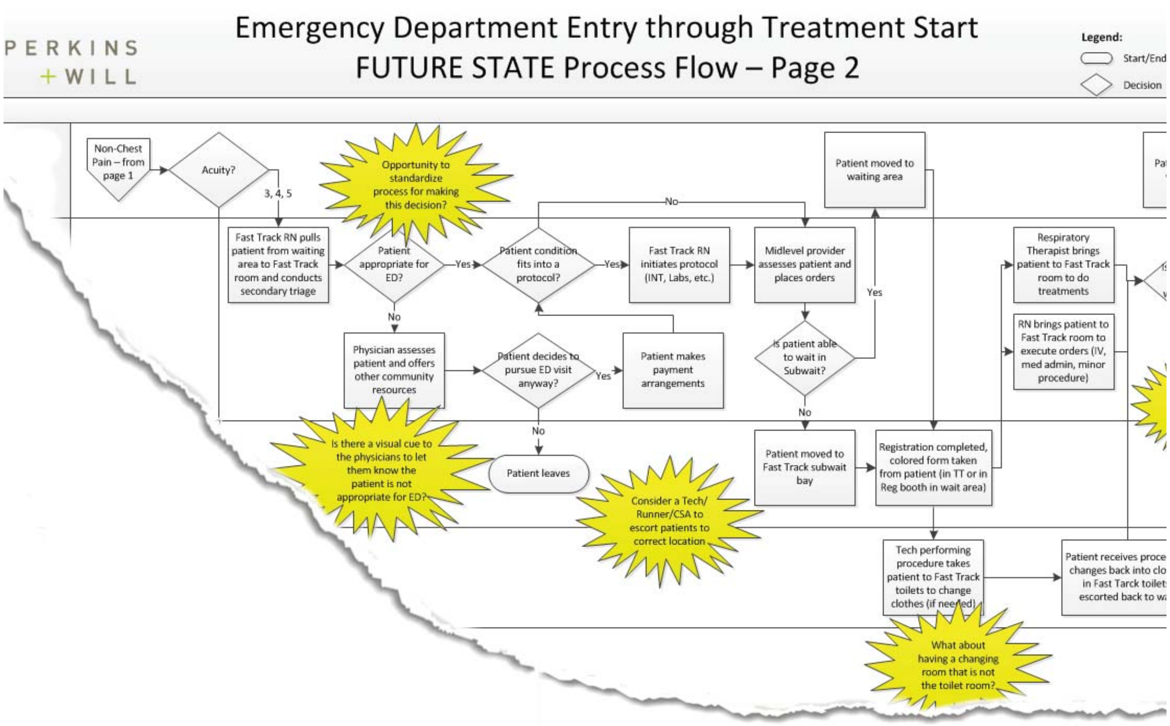

Figure 2: Process flow map of the future state.

2.3 Data Analysis

Next, the research team analyzed patient volumes and the impact of shifting care of patients to other areas within the department. The first step in the analysis identified how many patients were in the ED at any given time of day. This analysis demonstrated that the facility may need 71 spaces (including Waiting Areas) to care for Adults and 16 spaces (including Waiting Areas) to care for Children with current patient volumes. Next, the same analysis was completed for FT patients. This analysis suggested that 7 spaces were needed to care for current FT patients, and that the existing FT space (5 rooms + 3 recliners) was unable to accommodate any additional patient visits, as shown in Figure 3.

Data provided on patient visits that could qualify to be seen in FT (if there was capacity) was reviewed. The daily FT volume in current state was 52 visits, with the most patients at any given hour being less than seven, as shown in Figure 3. There were 122 additional visits per day identified that would qualify for FT, if there was space capacity. This represented a 235 percent increase in daily patient visits to FT, to 174 visits per day, with the most patients in any given hour being about 22, as shown in Figure 4. The analysis suggested that 24 spaces would be needed to care for the proposed FT patient visits.

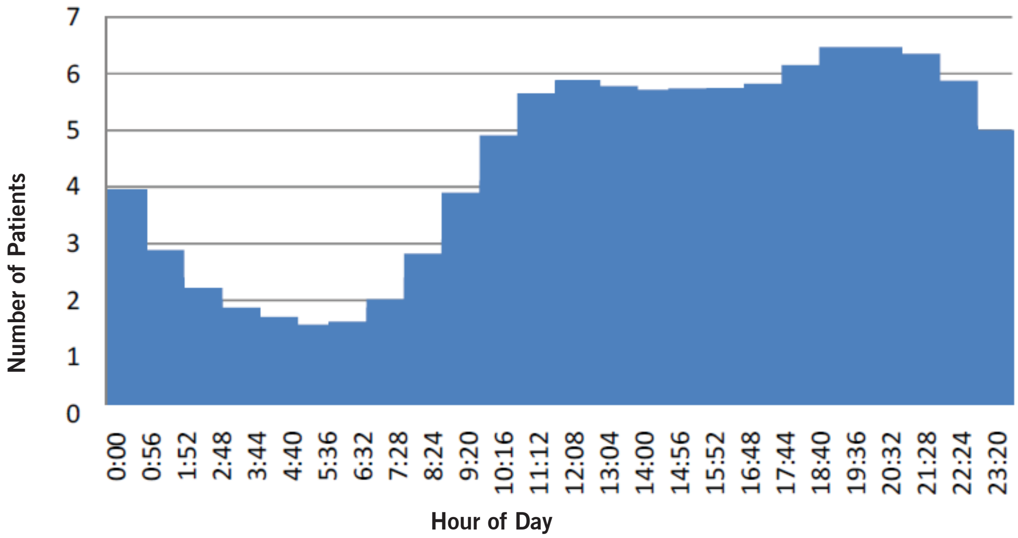

Figure 3: Current daily volume of patients in FT.

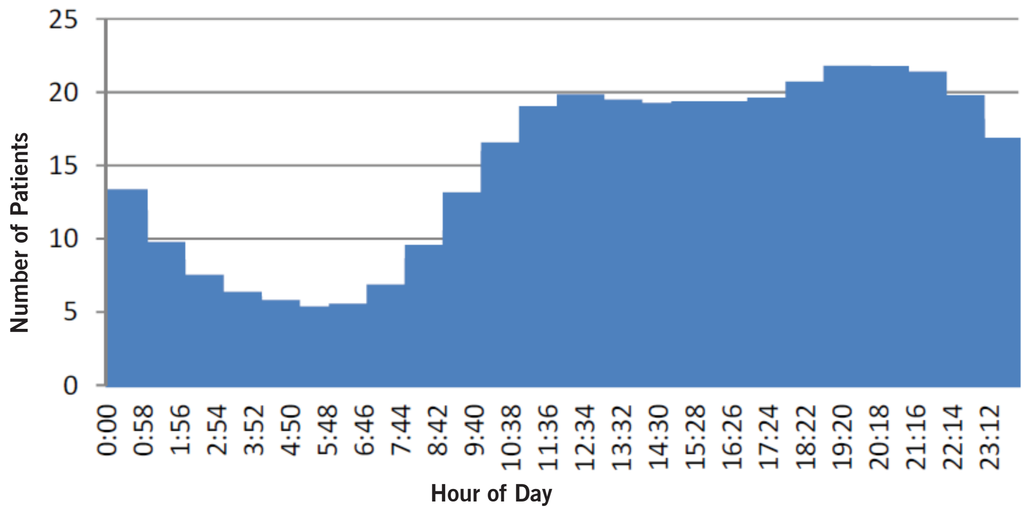

Figure 4: Proposed daily volume of patients in FT.

With only eight existing care spaces, and the analysis suggesting the need for 24 care spaces to accommodate a shift of patients from Main and CEC to FT, operational modeling was necessary to identify the impact to the Main and CEC spaces if these patients were shifted to FT.

2.4 Operational Modeling

Shifting 122 visits per day from care in Main and CEC to FT would certainly have an impact on the space needed by CEC and Main. Creating additional care spaces for FT would result in reduction in existing rooms in Main and CEC. Assuming the same average visit time for these additional 122 visits, the analysis demonstrated 241 hours of additional patient care per day that would take place in FT. This resulted in 10 additional FT spaces needed to accommodate the additional patient visits.

The team went on to identify the reduction in spaces needed in Main and CEC for patients that would now be cared for in FT. Assuming the same average visit time for the 122 visits that were shifted from Main and CEC to FT, the analysis showed that 527 hours of patient care each day would no longer take place in Main and CEC. This resulted in up to 22 Main and CEC spaces that would no longer be needed.

Based on this analysis, it was suggested that if the ED would like to shift patient visits from care in the Main and CEC to FT, the ED will need to add 16 more patient care spaces in FT to provide an additional 241 hours of care each day. Further, it was estimated that the ED may need 22 fewer patient care spaces in Main and CEC to provide 527 fewer hours of care each day. Results are shown in Table 2.

2.4 Potential Architectural Design

While the current state process map, future state process map, data analysis, and operational modeling were taking place, the research team designed a new Fast Track that alleviated the pressure on the waiting area and addressed many of the challenges identified in the current state process map. An initial design that was considered would be impacted by these analyses and simulation; but, the analysis informed the process in time to make some valuable changes before any construction. One of the possible floor plan solutions was reviewed with emergency department staff, and it was determined that the layout would not facilitate the privacy needed to pre-register and triage patients. The team is modifying the architectural design to allow for floating booths or tables that would facilitate privacy as well as flow of patients. The greeter desks were shifted to the shape of a triangle instead of a square. The triangle would facilitate more privacy for patients during quick registration and triage, increase communication between registration and clinical staff, and would allow better flow of patients upon entry.

Table 2: Comparison of the space requirements and patient volumes for FT, Main and CEC areas.

Fast Track Impact		Main/ Children's Impact	
Additional FT patients/day	122	Fewer Main/Children's patients/day	122
Increase in FT patient care hours/day	241	Decrease in Main/Children's patient care hours/day	527
Additional FT care spaces needed	16	Fewer Main/Children's care spaces needed	22

3.0 CONCLUSION

Based on this study, it was suggested that if the ED would like to shift patient visits from care in the Main and CEC to FT, the ED will need to add 16 more patient care spaces in FT to provide an additional 241 hours of care each day. Further, it is estimated that the ED may need 22 fewer patient care spaces in Main and CEC to provide 527 fewer hours of care each day.

The methods that were utilized to determine the requirements included observational study, process mapping, data analysis, and operational modeling. Additionally, Lean principles and concepts were utilized in designing the future state process map as well as the floor plan. Lean principles generally focus on the reduction of waste in a process. Lean design is the application of Lean principles to the design or architectural process. Lean methods applied to the design process result in designs that are developed faster, more operationally efficient, and with the elimination of waste.

REFERENCES

[1] Lean Enterprise Institute. A Brief History of Lean, Retrieved on 11/2012 from http://www.lean.org/WhatsLean/History.cfm.

[2] Sarkar, D., (2009). “Lean for Services”, PEX Process Excellence Network, Retrieved on 11/2012 from http://www.processexcellencenetwork.com/six-sigma-quality/columns/8-wastes-of-lean-manufacturing-in-a-services-conte/.

[3] The Lean Logistics Blog, (2010). “How To Create a Swim Lane Diagram”, Retrieved on 11/2012 from http://leanlogisticsblog.leancor.com/2010/09/01/how-to-create-a-swim-lane-diagram/.

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