Academy Journal

No. 19

Academy of
Architecture for Health

an AIA Knowledge Community

2017

No. 19

Contents

Mission of the *Academy Journal*

As the official journal of the AIA Academy of Architecture for Health (AAH), this publication explores subjects of interest to AAH members and others involved in the fields of health care architecture, planning, design, and construction. The goal is to promote awareness, educational exchange, and advancement of the overall project delivery process, building products, and medical progress that affects all involved in those fields.

About AAH

AAH is one of 21 knowledge communities of the American Institute of Architects (AIA). AAH collaborates with professionals from all sectors of the health care community including physicians, nurses, hospital administrators, facility planners, engineers, managers, health care educators, industry and government representatives, product manufacturers, health care contractors, specialty subcontractors, allied design professionals, and health care consultants.

AAH currently consists of approximately 6,000 members. Its mission is to improve both the quality of health care design and the design of healthy communities by developing, documenting, and disseminating knowledge; educating design practitioners and other related constituencies; advancing the practice of architecture; and affiliating and advocating with others that share these priorities.

Please visit our website at www.aia.org/aah for more about our activities. Please direct any inquiries to aah@aia.org.

Letter from the editor

This is a special 19th edition of the *Academy Journal*, published by the AAH knowledge community. It includes five articles published online last year and three new articles from this year that enhance the built environment for health care. Moving forward, we've decided to publish articles from the current year for both online and print distribution.

As the official publication of the Academy, the *Journal* publishes articles of particular interest to AIA members and the public involved in the fields of health care architecture, planning, design, research, and construction. The goal has always been to expand and promote awareness, educational exchange, and advancement of the overall project delivery process, building products, and medical progress that affects all involved in those fields.

Articles are submitted to, and reviewed by, an experienced, nationally diverse editorial review committee (ERC). Over the years, the committee has reviewed hundreds of submissions, responded to writers' inquiries, and encouraged and assisted writers in achieving publication. In its 19-year history, the *Journal* has provided valuable opportunities for new and seasoned authors from the architecture and health care professions, including architects, physicians, nurses, other health care providers, academics, research scientists, and students from the US and foreign countries.

Published articles have explored a broad range of medical topics, including research trends and the future of health care architecture, cardiac care, future and evolving technology, patient rooms and patient safety, lighting design for health care, psychology, workplace design, cancer care environments, emergency care, women's and children's care, and various health care project delivery methods.

We encourage graduates who have received health care research scholarships and others involved with research within the health care architecture field to submit their research to the *Journal* for publication consideration. We'll continue to develop a cross-referenced article index and a broader base of writers and readers. The deadline for the 2018 call for papers is May 31, 2018.

Since the late 1990s, this free publication has expanded to include worldwide distribution. We are proud to report that as our readership continues to grow, it also expands internationally. Readers have viewed the *Journal* online from the US, Canada, Europe, the Caribbean, Asia, Africa, India, and Saudi Arabia, just to name a few. The *Journal* is available to the 90,000 AIA members and the public on the AIA website at aia.org/aah.

My special thanks to AIA for its continued support and hard-working staff and to the many volunteers who have contributed to our growing and continued success. I would especially like to thank the other members of the 2017 ERC: Joyce Redden (TN); John Sealander, AIA, ACHA, NCARB, LEED AP (CA); Janice Stanton, RN, MBA, EDAC (IL); Donald L. Myers, AIA, NCARB (VA); Angela Mazzi, AIA, ACHA, EDAC (OH) and Sharon Woodworth, FAIA, FACHA (CA).

As always, we appreciate your feedback, comments and suggestions by emailing aah@aia.org or calling me at (631) 246-5660.

Orlando T. Maione

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Editor, Academy Journal
November 2017

Designing for Invisible Injuries: An Exploration of Healing Environments for Posttraumatic Stress

Valerie Greer, AIA, LEED AP, Professor of Practice, Washington University in St. Louis and Emily Johnson, research assistant, MS in advanced architectural design candidate, Washington University in St. Louis

ABSTRACT

Nearly 8% of Americans will experience the condition of post-traumatic stress disorder (PTSD). While post-traumatic stress results from a variety of causes, including abuse, assault, or natural disaster, it is most commonly associated with warfare. An estimated 30% of those who spend time in war zones will suffer from PTSD (U.S. Department of Veterans Affairs, 2015). Symptoms such as flashbacks, hypervigilance and substance abuse often lead to difficulties maintaining relationships, employment and health. In extreme cases, PTSD can be a primary cause of suicide (Eaton, 2012).

The US Department of Veterans Affairs reports that PTSD leads healthcare concerns among veterans, a population that shares specialized backgrounds and health risks (Morris, 2015). This paper examines the potential of design and the healing environment to positively contribute to the experiences of veterans working to recover from combat PTSD.

Examining challenges in the physical, social, and ambient environment through veterans' perspectives, a design studio at Washington University in St. Louis developed a series of proposals that combined outpatient therapy with a residential-based resource center. The design exploration reveals elements in the built and natural environment that uniquely resonate with veterans' experiences and play a significant role in the approach to creating spaces for behavioral health treatment.

Introduction

Written record of humans suffering from the mental, emotional and psychological toll of war dates back hundreds of years, from Homer's heroic quest in The Iliad to Shakespeare's tortured King Henry IV. Historically, this condition has been identified as shell shock, combat fatigue, and war neurosis. Today it is known as post-traumatic stress disorder, or PTSD.

Statistics indicate that one in three US veterans presents with symptoms of PTSD but fewer than 40% seek help (Veterans and PTSD, 2015). Suicide rates among veterans are twice as high as rates among civilians, with an estimated 22 veterans committing suicide every day (Kemp and Bossarte, 2012). Currently, the US Department of Veterans Affairs spends more than $3 billion per year toward care, yet high rates of drop-out from behavioral health treatment programs persist (Morris, 2015).

The current PTSD treatment approach consists of a combination of biomedical therapies and psychotherapy to treat immediate symptoms and the subsequent underlying cause. Common psychotherapy treatment for PTSD consists of prolonged exposure therapy (PE) and cognitive processing therapy (CPT) (Understanding PTSD and PTSD Treatment, 2016). Both approaches are based on the premise that talking through trauma yields healing. This approach often runs counter to the training and culture ingrained in the military. Marine veteran David Morris writes in his book, The Evil Hours, "I began to think of the treatment not as therapy so much as punishment. Penance" (Morris, 2015).

In 2007, a program called "Ocean Therapy" was piloted at Camp Pendleton where veterans struggling with PTSD were taught how to surf. Veterans and counselors met in group therapy sessions after surfing, and participants began showing decreased symptoms in just five weeks. Since then, more than a thousand Marines have been through Ocean Therapy and have continued to positively improve. Researchers are currently studying reasons for success. These researchers believe that endorphins produced while surfing counteract the depletion of norepinephrine and serotonin—often symptoms of PTSD. Visual and auditory connections to water contribute to this phenomenon by reducing stress and allowing positive memories to begin to overwrite negative memories. This process begins to alleviate illnesses like insomnia and depression, which often accompany PTSD (Wallace, 2014).

Building on the success of Ocean Therapy and the call to reexamine the treatment of PTSD, Washington University in St. Louis conducted an architectural design studio where graduate students investigated the psychological and social aspects of combat PTSD. The studio teamed with veterans, spouses, therapists, and healthcare designers. Students were asked to suspend pre-conceptions of PTSD to understand the condition through first-hand narratives and research.

The studio considered how military experience uniquely shaped perception. For example, veterans are trained to survey their surroundings in highly specific ways. The ability to successfully operate in combat zones depends on a sophisticated aptitude for analyzing and navigating through a potentially hostile environment. This deeply ingrained hypervigilance becomes a symptom of PTSD when it begins to interfere with a return to civilian life by continuously sending fight-or-flight signals to the brain.

Because psychologists largely agree that the physical environment can positively impact the behavior of patients suffering from mental health disorders, studio participants posed the following questions:

- How does advanced visual training inform the approach designers should consider when creating therapeutic spaces for veterans?
- Which aspects of the environment most effectively contribute to behavioral health treatment?
- In what ways can the transition from military life to civilian life be considered in the design process and approach to behavioral health environments for veterans?

Students built on research and analysis to develop proposals for a veterans Center for Ocean Therapy, which combined a suite of inpatient and outpatient resources with transitional housing. Engaging veterans in design reviews provided the studio with a window to understanding the design problem and the environmental variables that uniquely resonate with healing.

This paper describes the research, analysis, catalogue of issues, and concepts explored to further the discussion and understand how design can positively shape healing environments and outcomes for veterans struggling with behavioral health conditions such as combat PTSD.

Research

The studio began with individual and collective research as students engaged in readings, films, and discussions with veterans. Emily Johnson, research assistant for the Center for Health Research & Design, gave a lecture about the history of asylums and the 'moral model' of treatment for mental health. Architect Matthew Finn lectured on the research project he conducted through the Perkins + Will Innovation Incubator on Post Traumatic Understanding (Finn, 2013). Students also watched the accounts of WWII veterans suffering from 'nervous conditions' in the John Huston documentary "Let There Be Light."

As a result of exploring combat PTSD—including its stigmas, stereotypes, and the myriad therapies in practice today—students created a research graphic to convey the complex conditions veterans may encounter when seeking behavioral health treatment.

A study by Maeve Elder (figure 1) stems from first-hand accounts the student collected and depicts simultaneous realities a veteran may face through experiencing flashbacks. The exploration is a collage of a scene from a convenience store and a street in Iraq, likening a visual analysis of everyday products on a convenience store shelf with an analysis of elements from a war-torn residential street. Through her research, this student was struck by how commonly flashbacks blur realities from military and civilian life, conflating 'everyday' and 'real.' The image reflects this condition of dual realities and provides insight into how military training and advanced perception skills may alter the experience of navigating through civilian spaces.

Muhong Zhang's exploration (figure 2) likewise derives from first-hand narratives of veterans, tracing the transition of soldiers from civilian life to basic training to deployment and then back to civilian life. The student was interested in the physical transformation of this journey, beginning with the scale of the body and the social and cultural constructs that define each stage of experience.

Dara Smyth alternatively focused on social stigma and the fluctuating relationship between veterans and society (figure 3). The research was inspired by accounts of veterans who served in different wars. Depicting both a Vietnam War veteran and an Operation Enduring Freedom veteran, the study illustrates the historically bifurcated relationship between society and veterans, with the veteran depicted as both outcast and hero. Images of the two veterans are mounted as reliefs on Plexiglas, presenting veterans both as individuals and as symbols associated with the social stigma of war. This drawing prompted awareness around the social isolation veterans often encounter upon returning from deployment, as well as the reward they may experience when connecting with other veterans who served in different eras.

Environmental analysis

Following this initial stage of research, the studio traveled to Southern California where students met with Dr. Carly Rogers, founder of Ocean Therapy. Students investigated sites identified for the Veteran's Center project along Santa Monica Beach and had the opportunity to take a lesson in surfing, which gave them the ability to experience the ocean first-hand. Synthesizing experiences of the site, climate, and ocean with the opportunity to speak with Dr. Rogers and veterans, students created an analysis exploring environmental variables that could uniquely contribute to a therapeutic healing environment.

Analysis of the built environment through veterans' perspectives informed design thinking significantly. Speaking with the studio, one veteran shared his first memory of the built environment after returning from Iraq. He recalled stepping out of a car in downtown

FIGURE 1

Image credit: Maeve Elder

FIGURE 3

Image credit: Dara Smyth

FIGURE 2

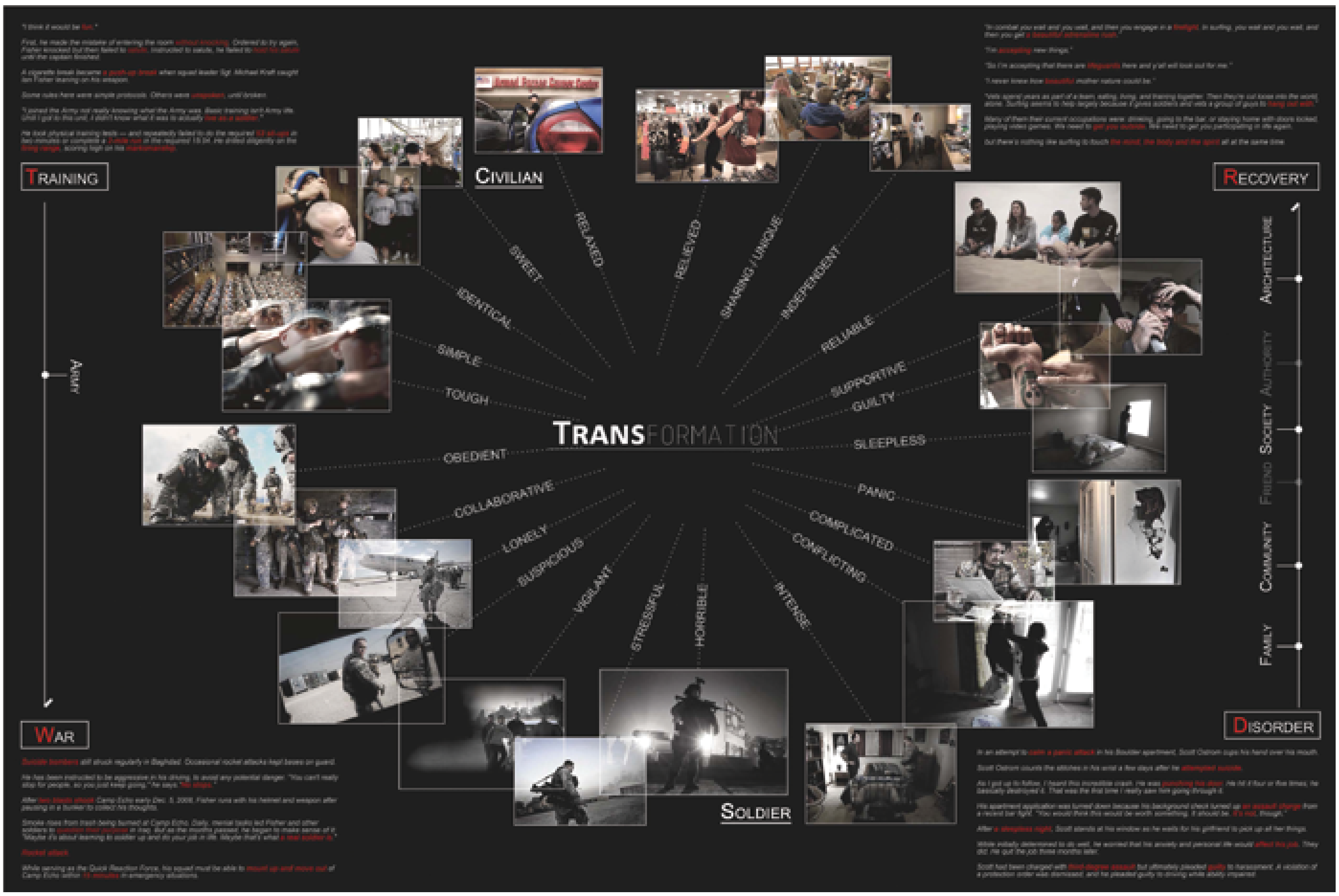

Image credit: Muhong Zhang

Los Angeles where he was overwhelmed and terrified by the sheer number of windows surrounding him. Throughout his deployment as a Marine, he was trained to survey new environments by visually scanning and 'clearing' them—checking windows, for instance, for threats such as snipers. With hundreds of windows presented from all directions in downtown Los Angeles, it was an impossible instinct to fulfill, causing heightened adrenaline and anxiety (Hayden, 2016).

Accounts like this and others prompted students to analyze the built environment as a veteran might, as shown through Stacy Witschen's analysis in figure 4. The graphic presents a kind of mental map that distinguishes various features of the urban, residential, and natural environment. Paths of pedestrian travel around the site differ greatly as does the character of urban and residential spaces surrounding the site. This two- and three-dimensional mental map overlays a record of open versus constricted spaces with photographs, recollection of memories from military experience, facts known about the history of the site, and colors that simply represent an emotional reaction to the built environment.

Katheryn Haas explored the potential to shape daylight as a means of supporting circadian rhythms and sleep patterns (figure 5). She identified the connection between various activities and optimal times of day because night terrors and insomnia are commonly experienced symptoms of PTSD. Therefore, designing a breakfast room and group counseling spaces with strong eastern light might support waking, gathering, and focused discussion in the first part of the day, whereas a courtyard designed with shade might invite rest and relaxation after lunch.

Acoustics were another environmental variable explored. The study 'Site as Sonograph' by Maeve Elder (figure 6) reflects a series of audio recordings the student took on site. Bordered by a historic building, low rise residential, a city park, and the beach, the site is largely defined by a 20-foot grade shift, transitioning from a neighborhood to the beach. A wide range of sounds were recorded—from birds chirping and palms rustling in the direction of the park, to vehicular traffic and voices in the direction of the city. On certain parts of the site, one can hear the sound of waves crashing on the beach. This led to an interest in understanding the qualities of sound on the site because noise is a common trigger for flashbacks. Mapping sound as a form of topography allowed the possibility of shaping sound as a key environmental variable. This became particularly critical in supporting the creation of indoor and outdoor spaces later in the studio.

FIGURE 4

Image credit: Stacy Witschen

FIGURE 5

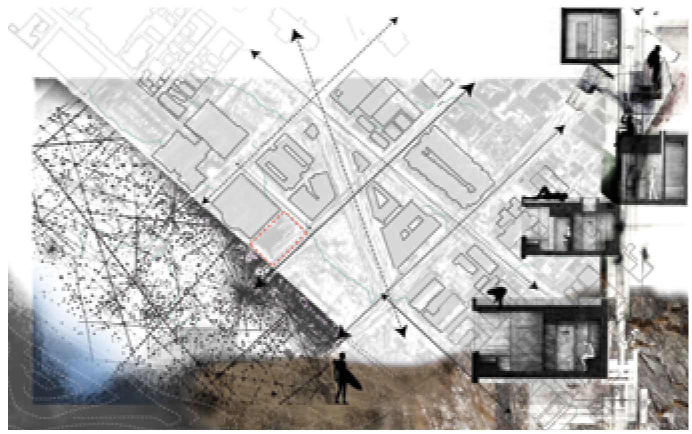

Image credit: Katheryn Haas

FIGURE 6

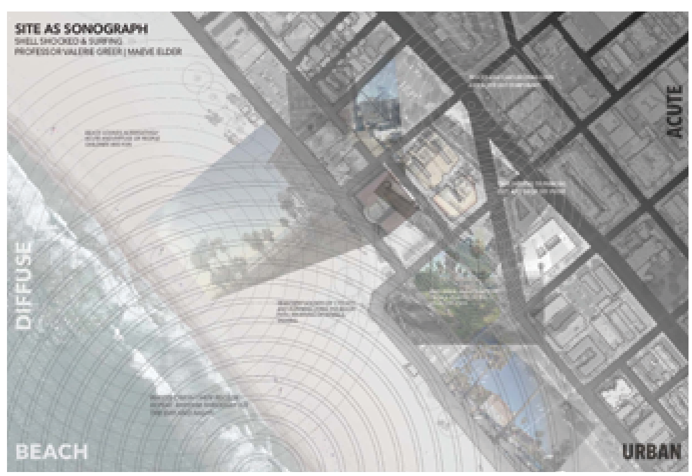

Image credit: Maeve Elder

Design concepts

Following research and analysis, students designed a Veteran's Center for Ocean Therapy, a residential based treatment center with transitional housing for 40 veterans. The Center accommodates outpatient services such as access to ocean therapy, group and individual counseling, exercise facilities, physical therapy, and a career center for both resident and local veteran use. Shared amenities include dining, recreation, a workshop, and a family area for resident and local veterans, along with a plaza or landscape to benefit the larger community.

Students applied the body of research and analysis to generate concepts for healing environments.

Four major themes drove projects, providing insight and thinking into the future design of behavioral health environments for veterans: Thresholds and transition, comradery and community, mind and body, and awareness and engagement.

1. Thresholds & transition

Drawing upon the research and a guest lecture by Perkins + Will architect Matthew Finn, students gained an appreciation for many veterans' sensitivity to thresholds. Doors, stairs, and corridors present danger when navigating through combat conditions, and that vulnerability often lingers in the way veterans react to thresholds in the built environment. A local veteran described the concept of establishing a 'dominant position' when moving through zones of compression. He shared that, after moving through a door and into a room, his instinct is to stand with his back to a corner to survey all doorways.

Corey Stinson explored thresholds and transition in the project Peripheral Limit: Reframing Mental and Psychological Thresholds (figure 7). This led him to explore the potential of creating spaces that are positively associated with transition. Instead of creating thresholds through halls and doors, the student investigated ways in which light and shadow or hard and soft materials can help create thresholds. This approach aims to dismantle hard boundaries while creating an atmosphere that unites indoor and outdoor spaces and offers a simultaneous experience of protection and connection throughout the environment.

Working on a different site, Alexandra Ward investigated thresholds through a series of diaphanous layers that create a gradient between public and private spaces. Shown in figure 8, Ward conceived of the program as a series of indoor and outdoor rooms united through a wood frame structure, with a minimal use of corridors. Within this system, conventional walls protected private spaces while semi- private and communal spaces were defined by vertical slats. Articulating the assembly of this system served two purposes. The first was to celebrate the construction of the building, providing visual stimulation and order. The second was to provide an operable layer of louvers, giving occupants kinetic control over the privacy of spaces.

FIGURE 7

Image credit: Corey Stinson

FIGURE 8

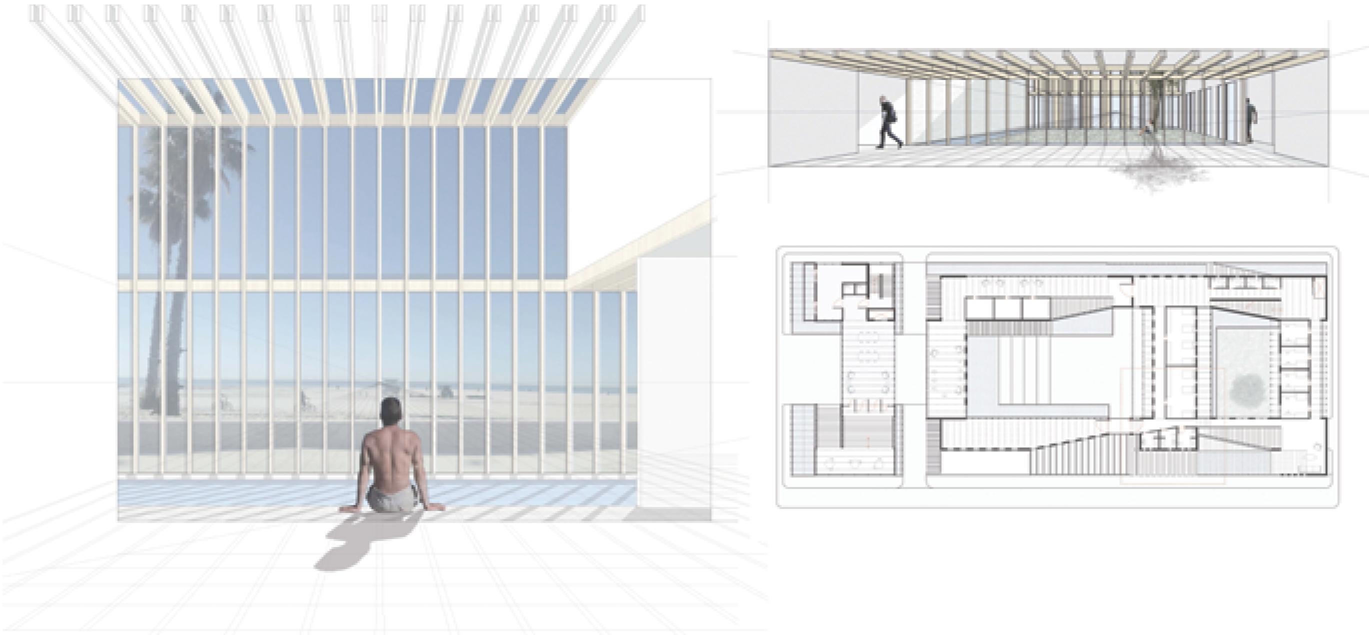

Image credit: Alexandra Ward

FIGURE 9

Image credit: Kuai Yu

Kuai Yu explored a sectional approach to thresholds in the project Transition (figure 9). As the concept diagram illustrates, Yu started with a stratified organization of communal, residential, and therapy spaces. She then introduced a series of shared outdoor areas and began blurring boundaries between spaces, working with half levels and ramps to create visual connections between people and activities.

These three strategies illustrate different approaches to creating a tactile connection between occupants and their surroundings to generate positive experiences associated with thresholds and transition in the healing environment.

2. Comradery & community

Another theme that the studio explored was the comradery and sense of community veterans often experience while serving in the military. A sense of isolation following a return to civilian life may stem from a loss of comradery and can be compounded by an inability of friends and family to relate to veterans' military experiences.

The idea of comradery drove the planning in the project Cultivated Vitality by Jay Schwartz, figure 10. Residential units are organized into a set of smaller neighborhoods, likened to squadrons. Units are designed to house 8 to 10 veterans, and each unit is directly connected to one of the outpatient resources such as the counseling suite or family area. The concept was to encourage bonding among members of each unit while also creating a sense of community around outpatient areas. This structure of neighborhoods creates a large central courtyard looking out onto the beach, a space for gathering at the heart of the center.

An alternate strategy to building comradery is seen through the project Communal Progression by Dylan Weber Callahan (figure 11). Here outpatient resources are integrated into the base of the building, with direct access from the beach and the street. Lifted above this community base are a series of residential blocks organized in a gradual arc. The concept was to create an intimate scale of bonding within residential areas while also creating a way for groups to be visually connected to each other at a larger scale. This strategy allowed the project to engage a historically significant neighboring building while creating a central outdoor plaza that connects veterans to each other and to the surrounding community.

Although the two project approaches differ, their common underlying design goals were to enhance comradery through the organization of the program.

FIGURE 10

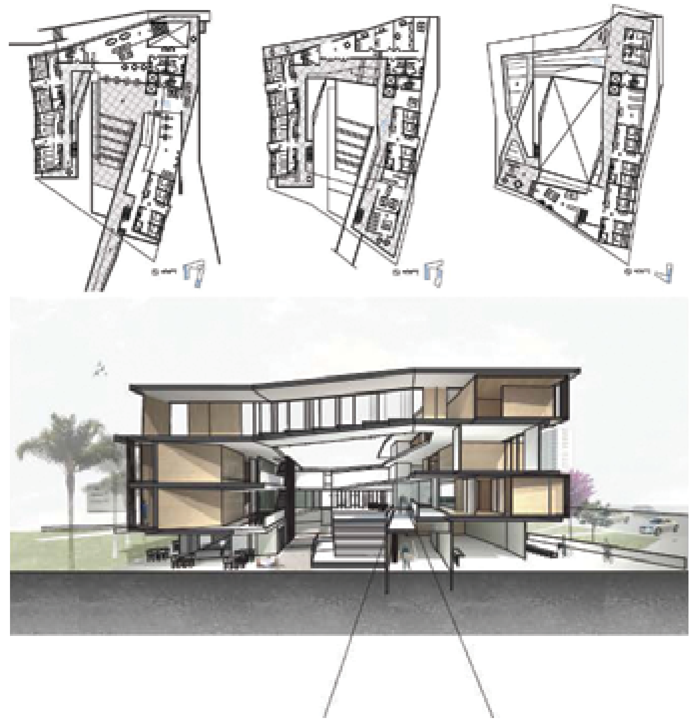

Image credit: Jay Schwartz

FIGURE 11

Image credit: Dylan Weber Callahan

3. Mind & body

Closely associated with comradery is the bonding established through physical exercise and exertion. Veterans frequently remarked, for instance, that the gym would be the most popular place in the Center. Ocean therapy builds on the physical and mental exertion required to surf, harvesting the power of the ocean and adrenaline from surfing to help veterans open up around the emotional and psychological challenges they may be facing. Labyrinths, at a slower pace, similarly engage mind and body and have been shown to be an effective therapeutic tool in working with PTSD (Anderson, 2011).

Muhong Zhang's project Invisible Link (figure 12), creates a strategy of journeying through the site as a way to engage body and mind. This student took a sectional approach, nesting the program into the slope of the site with a system of ramps and outdoor spaces, thereby transforming an experience of the Center into a journey through the site. Residential neighborhoods are centrally located with the gym and therapy spaces facing the beach to the west. To the east, the business center, dining, and recreation hall optimize a connection to the neighborhood. Zhang designed different scales of social spaces throughout as well as a sloped landscape that traverses the site and connects local and resident veterans to each other and to the shared experience of travelling through the site.

Another investigation into the body and mind connection led Katheryn Haas to investigate how daylight can support circadian rhythm in Circadian Space (figure 13). Here, specific qualities of light animate a series of active and restful spaces. Haas designed sleeping spaces for diffuse, ambient light to enter in the morning and stronger sunlight to filter into a breakfast area, therapy suite, and workshop in the late morning. A quiet and cool space tucked away from the beach was designed for an early afternoon rest or a place to shower after surfing. Alternatively, a climbing wall that rises up from the beach level and was designed to be animated by late afternoon sun. This climbing wall penetrates vertically through several levels of the building, bringing veterans to a sunset platform and back to the private residential living levels. Thus, the design creates a shared journey throughout the day and celebrates exertion and rest.

FIGURE 12

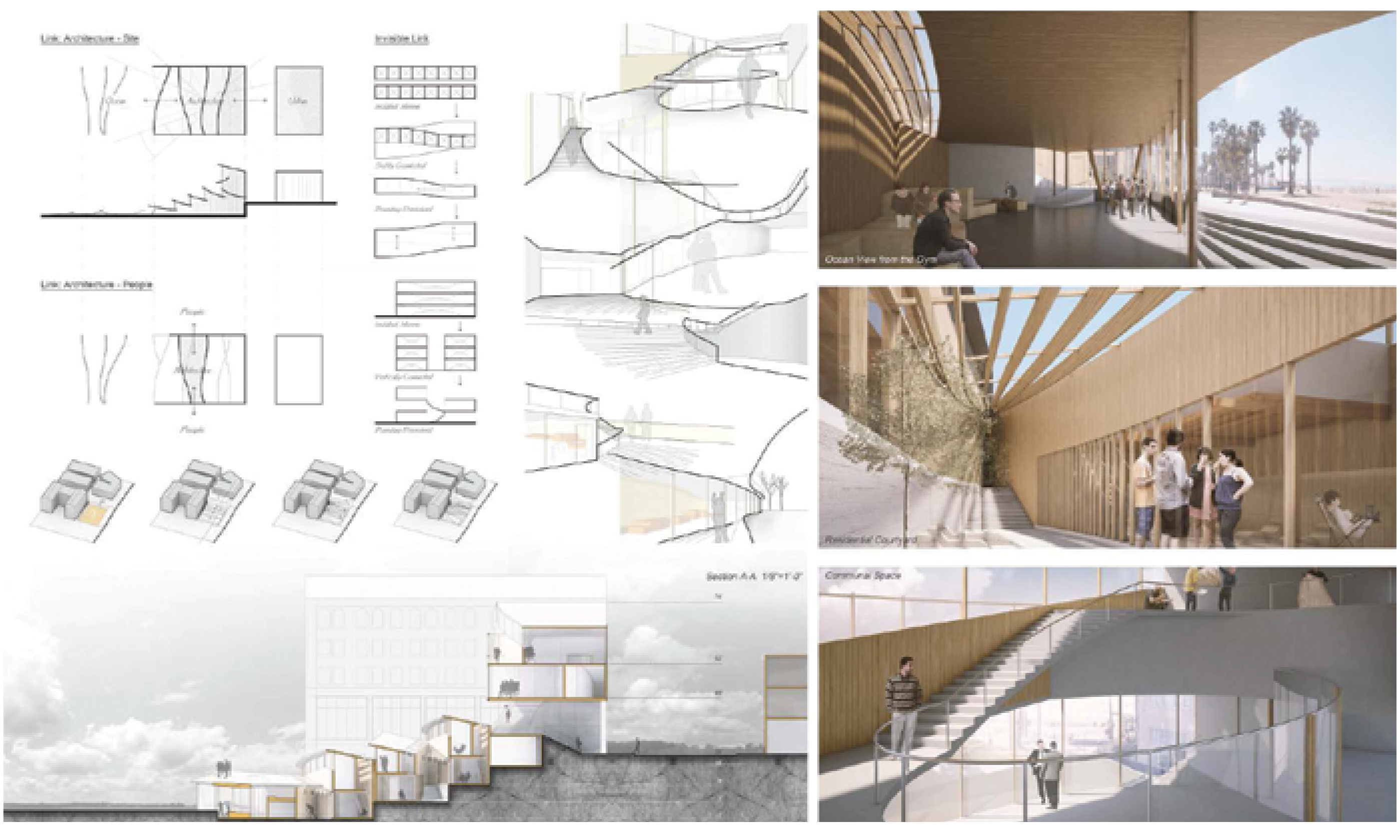

Image credit: Muhong Zhang

FIGURE 13

Image credit: Katheryn Haas

FIGURE 14

Image credit: Andrew Calbert

4. Awareness & engagement

A final theme that emerged was the concept of post-traumatic growth, or positive psychological changes that may result from adversity (Morris, 2015). Through discussions with veterans, students learned that awareness and engagement is imperative to post traumatic growth, which reveals a dimension of ways in which veterans can positively emerge from the challenges of combat PTSD.

Andrew Calbert's project, Grey Space: From Soldier to Civilian (figure 14), expresses components of the program architecturally to visually distinguish different among activities and services found at the Center. The workout area cantilevers a level above the beachfront, for instance, while private living quarters are nested among roof gardens. Calbert based this campus concept of creating a choice of destinations on the idea that design should celebrate and promote awareness of available resources. The project proposes a plaza to connect the neighborhood to the beach through a military service garden, providing a place for public gathering, reflection, and education.

Dara Smyth developed the ideas of celebrating service and engaging the community in her project, Mediated Exposure (figure 15). Through discussions with veterans who shared personal experiences of post-traumatic growth, the studio learned about the importance of service and finding ways to contribute positively to the community upon return to civilian life. The studio also learned how creativity often accompanies post-traumatic growth. This inspired Smyth to conceive of the woodshop and kitchen as points of gathering between veterans and the community—proposing that veterans could teach local teenagers how to build surf boards in the shop, for instance, and run a teaching kitchen that serves a neighborhood café. The woodshop and the café are connected through a tribute garden, a contemplative public landscape that promotes reflection, awareness, and understanding of veterans' experiences both throughout deployment and upon return to civilian life.

Connecting Fragments, a project by Stacy Witschen (figure 16), organizes a layer of ground floor programmatic functions that interface with the neighborhood and community—including the library, welcome center, workshop, and family space—followed by a second layer of functions that interface with the beach and are more private for veterans' use. These two layers connect through courtyards and open spaces that weave veterans and the community together, allowing for an everyday awareness of the work, activities, and community hosted in the Veterans Center.

The potential to actively engage the community in the work of behavioral health treatment centers connects to the potential for post-traumatic growth by building awareness and appreciation of the many ways in which veterans contribute positively to civilian life.

FIGURE 16

Image credit: Dara Smyth

FIGURE 15

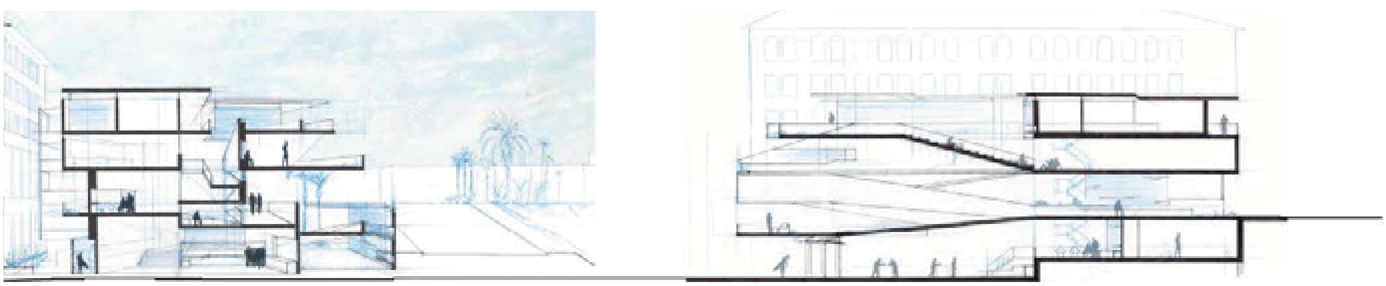

Image credit: Dara Smyth

Conclusions

Imaginative empathy is one of the most powerful tools available to architects and designers. This empathy is critically needed in the design of behavioral health treatment centers. Although PTSD impacts young and old, men and women, the challenges that veterans face when struggling with combat PTSD are uniquely shaped by military experience. An understanding of veteran perspectives, experiences, and challenges should inform the design of healing and recovery environments.

This paper aims to identify issues and elements in the built and natural environment that may be applied to making a positive impact for veterans and others suffering from PTSD. The following implications and potential applications can be summarized as follows.

- Research identifies certain design elements that can both trigger and alleviate anxiety for individuals coping with PTSD.
- Responses to physical and ambient environmental factors are often uniquely shaped to veterans' experiences and training in the military.
- Engaging thresholds and transitions in a particularly sensitive manner may be particularly important to shaping veterans' experience of the built environment.
- Shaping space to reinforce a sense of comradery and community may support the creation of positive social connections associated with therapeutic healing environments.
- Organizing programmatic elements in a way that engages mind and body may enhance the process of physical and psychological healing.
- Creating opportunities for veterans to engage with community and service while in a therapeutic healing environment may support the opportunity for post traumatic growth.
- The projects proposed a host of new innovative programmatic solutions for veterans and individuals experiencing PTSD, such as ocean therapy, as an addition or alternative to the standard treatment facilities often associated with mental health facilities and the US Department of Veteran Affairs.

Though the studio emphasized the impact of healing environments in the context of a facility for veterans suffering from PTSD, concepts and themes discovered can have a greater impact on the approach to the design of healing environments for behavioral and mental health.

Acknowledgments

Thank you to the veterans, spouses, therapists, architects, and professors who contributed to the discussions and design reviews of the studio:

Eric Cesal, Washington University in St. Louis
Gia Daskalakis, Washington University in St. Louis
Elizabeth Dunn, St. Louis University
Matthew Finn, Perkins + Will
Troy Fosler, Koning Eizenberg Architecture
Jessica Fosler, HOK
Kelly Hayden
Maggie Hayden, Christner Inc.
Derek Hoeferlin, Washington University in St. Louis
Philip Holden, Washington University in St. Louis
Anna Ives, Patthern Ives
Paul Joshu
Bruce Lindsey, Washington University in St. Louis
Javier Maroto, Washington University in St. Louis
Pablo Moyano, Washington University in St. Louis
Robert McCarter, Washington University in St. Louis
Mike Pereira
David Polzin, Cannon Design
Dr. Carly Rogers, Jimmy Miller Memorial Foundation
Jeff Ryan, Christner Inc.
Alex Smith
Jake & Katie Sparkman
Jan Ulmer, Washington University in St. Louis

Studio members, Masters of Architecture degree candidates:

Andrew Calbert
Dylan Weber Callahan
Maeve Elder
Katheryn Haas
Xingguang Li
Jay Schwartz
Dara Smyth
Corey Stinson
Alexandra Ward
Stacy Witschen
Kuai Yu
Muhong Zhang

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Hospital Inpatient Unit Design Factors Impacting Direct Patient Care Time, Documentation Time, and Patient Safety

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ABSTRACT

This study attempts to discover design strategies that support increasing nurses' patient care goals of direct patient care time, safety, and quality. This is a national-scope study of 14 inpatient units with various typologies. The study uses ratings of 135 nurses who work in these units gained from online surveys and correlated with unit typology classifications based on analysis of floor plans of the units where these nurses work. The findings discovered certain locations and qualities for support resource locations (medications, supplies, and equipment), that are most beneficial to nurses' patient care goals, and which types and locations of collaboration locations and electronic medical record workstations are more effective. Results of the study are usable by architects in designing or remodeling effective inpatient care units.

The findings of the study confirm that reducing walking distance benefits the patient care goals for support resources, but goes beyond that to discover that zoning of supplies into modules may be even more important. The study further found that medication room size is an important indicator of patient safety. It's more important to know where equipment items are stored consistently than to reduce the distance to equipment rooms.

Healthcare staff favored documentation locations closest to a patient. Closest was best.

Introduction

Which design factors work best to increase nurses' direct patient care time, safety, and quality? This study attempts to answer this question in a national-scope study of 14 inpatient units with various floor plan concept typologies. The study uses ratings of 135 nurses who work in these units, correlated with unit typology classifications based on analysis of floor plans of the units where these nurses work.

The findings show locations and qualities for support resource locations (medications, supplies, and equipment), that are most important to nurses and types and locations of collaboration locations and electronic medical record workstations that are more effective. Architects can use the study results to inform designing or remodeling effective inpatient care units. A team of architects performed the research, supported by nursing and research advisors and by an Academy of Architecture for Health Foundation research grant.

Background

Architects frequently hear the following objectives for hospital acute care inpatient units (beyond those of treating illness or aiding recovery from surgery or trauma) from hospital clients:

- quality of care
- patient safety
- staff safety
- staff satisfaction
- patient experience/satisfaction
- family participation/education
- reduction of distraction and interruptions for effective staff concentration
- multidisciplinary collaboration
- lean operations

When designers, working with hospital end-user committees, are planning a new hospital inpatient care unit, they are faced with difficult choices in configuring staff work and support resource areas within an overall unit plan to accommodate all of these objectives.

Context and program differences for each inpatient unit design include the following:

- variation in unit size (number of beds) and shapes (racetrack, triangles, Ls)
- specialization (medical, surgical, ortho, neuro, oncology, progressive care, etc.)
- varied nursing practice models
- different types of electronic medical record systems and degrees of adoption
- varying ancillary support methods (nurse servers vs. supply alcoves vs. central supply rooms; central medication rooms vs. satellite med stations, equipment inventory and degree of decentralization, etc.)

Within the context of overall organizational strategies and flow concepts, architects must make choices as to the degree of decentralization for locations of spaces for documentation, collaboration, and support resources.

In inpatient care units (IPU) today, nurses are challenged to have adequate time for direct patient care due primarily to a higher level of patient acuity. (Hendrich et al., 2007), in their time-motion study of how nurses spend their time, found that nurses only spend 19% of it on direct patient care.

Electronic medical records (EMR) systems now allow nurses to decentralize their documentation activities in the unit, with the promise of more time at the bedside. In their comparison of centralized and decentralized units, (Gerascio-Howard and Malloch, 2007) concluded that in the decentralized unit, RNs were able to spend more time in patient rooms (30% for decentralized vs. 26% for centralized). However, if decentralization of documentation isn't accompanied by the effective location and quality of support resource centers (medications, supplies, linens, equipment and collaboration spaces), nurses must take extra time to access these spaces, which reduces available time for direct patient care and documentation. There is a need to understand the nurses' perspective of how different locations and types of spaces for documentation, collaboration, and support resources contribute to their patient care goals.

Documentation

The most frequent and continuous activity for nurses is documentation of medical records and care coordination/planning (56% in the study by (Hendrich et al., 2007). EMR's emergence shows that it allows freedom of decentralization and ubiquitous access not possible in the past. Many solutions have emerged to accommodate this activity—corridor alcoves; open spaces near corridors, satellite groupings, and in patient rooms. (Cai and Zimring, 2011) posit that there are four typologies for nurse stations: central, sub-nurse stations (satellite stations), pod clusters, and mobile.

Collaboration

In some cases, decentralization has led to reduced communication and mentoring among caregivers. Becker (2007) suggests the importance of collaboration, mentoring, and consultation in creating a "community of practice" for quality of care on the unit. (Cai and Zimring, 2011) cite numerous studies showing reduced communication among nurses in units with decentralized nurse stations. (Zborowsky, et al., 2010) compared centralized and decentralized units and found communication with medical staff and other social interactions were reduced in the decentralized units. (Gerascio-Howard and Malloch, 2007), in their comparative study of centralized versus decentralized units, report that "RNs regretted a lack of contact with care partners and information lost from fewer networking opportunities." However, they also noted that a nurse locator system created opportunities for team communication. Decentralization in and of itself doesn't necessarily imply a lack of communication—specific design solutions definitely play a part. (Trzpuc and Martin, 2010) studied three types of decentralized units. Using space syntax methods, they concluded communication is enhanced by open visibility, allowing opportunistic meetings, and accessibility (path length).

Support resources

The need for decentralization of medications, supplies, and equipment spaces to reduce nurse walking distance is often cited as a way to deliver safe, efficient and effective patient care. (Hendrich, et al., 2009) found that nurses spend 17%of their time administering medications. (Cardon, 2011) points out that medication errors are a significant factor related to distance between medication rooms and patient beds. Her study shows that one-third of the medication errors occur during the administration of the medication, from interruptions along the way, and from batch processing of multiple orders that can lead to dosing the wrong patient.

Hypothesis

The hypothesis of this study is that the location of the EMR documentation spaces, collaboration spaces, and support resources (medications, supplies, linens and equipment) locations have an impact on nurses' direct patient care time, documentation time, safety, and overall effectiveness (effectiveness criteria). More specifically, we hypothesized that nurses would favor unit designs with the shortest average walking distance between these resources and the patient. The study was designed to correlate a detailed survey of nurses' ratings for their unit design, using the effectiveness criteria, with the physical features of the floor plan. By comparing multiple units, we hoped to show that nurses would judge certain units' features are more successful than others in supporting the effectiveness criteria.

FIGURE 1

Floor plan example: MultiCare Good Samaritan Hospital 6th Floor Medical Unit, Puyallup, WA
Image credit: Clark/Kjos Architects, LLC

FIGURE 2

Floor plan example: Providence Medical Center 8-N Orthopedics, Portland OR
Image credit: Clark/Kjos Architects, LLC

Methodology

Fourteen units were included. Design architects of each unit provided digital floor plans. The research team normalized floor plans for consistency and confirmed exactly how each unit was being used.

Four nurses from each shift at each facility completed a detailed survey. Questions sought ratings of how certain locations of support resources supported patient care goals. Rating questions allowed the nurses to respond on a 1–5 scale: from 1 (not at all effective) to 5 (very effective). Nurses' ratings for each unit were averaged to create one score for that facility.

This research investigates three interrelated design problems for inpatient unit support resources, described below.

Support resources spaces

Research question: Is there a correlation between the location of certain support resources (medications, supplies, equipment), and nurses' perception of their impact on direct patient care time, documentation time, and patient safety?

Nurses' ratings were correlated with average distance between the patient room and the closest medication station(s) to accurately test the hypothesis that the nurses would feel that shorter walking distances would support the three patient care goals.

Medications

See table 1, which correlates distance to nurse rating of the resource location's support of the three patient care goals (higher distance, in feet, should equate to a lower time availability, while higher rating scores indicate more time for the nursing goals). Colors help to visually express the pattern of values, from red for long distances to green for short distances, and the same scale for low to high ratings. The data shows that there is a correlation of travel distance to the nurses' ratings of support for the patient care goals. Approximately one-third of the units are outliers and do not correlate well. Therefore, the research team concluded that additional factors figure in the nurses' ratings.

Comments from the nurses included the point that frequently there is a wait at the medication dispensers, offsetting the proximity advantage some of the time, so we attempted to correlate number of patients served by each med room (more beds per med room would indicate more time delays, while higher rating scores indicate more time for the nursing goals). See table 2. However, there was no consistent correlation.

There is anecdotal evidence that availability of work space in medication rooms can be a factor in patient safety. The research team correlated nurse safety ratings with two different factors:

TABLE 1

	Norton Brownsboro	Harrison 2S (Med/Surg)	Harrison 2W (Oncology)	Good Sam Puyallup 6	St. Charles 3 Ortho Unit	St. Charles 4 Medical Unit	Good Sam Puyallup 4	Prov Portland 8N (Ortho)	Emory Johns Creek Hosp.	St. Charles Redmond	Good Samaritan Corvallis	Samaritan Lebanon	Prov Portland 8S (Neuro)	Samaritan Albany
	Centralized serving 21+	Decentralized serving 11-20	Decentralized serving 11-20	Centralized serving 21+ patients	Centralized serving 21+	Centralized serving 21+	Decentralized serving 11-20 patients	Decentralized serving 5-10 patients	Decentralized serving 11-20	Centralized serving 21+ patients	Decentralized serving 11-20	Corridor cabinet serving 1-4 patients	Decentralized serving 5-10 patients	In pat room (nurse server) and central location
Ave dist to combined locs	78	71	70	70	55	45	44	41	38	37	35	34	28	10
Time for care	3	2.4	3.3	4	3.6	3	3.3	3.9	3.9	3.8	2.9	4.3	4.1	3.9
Time for documentation	3.5	2.8	3.1	3.9	3.9	3.1	3.2	4	3.9	3.8	2.8	4	4.1	3.6
Patient Safety	3.9	3.5	3.3	3.9	3.9	3.1	2.8	4.1	4.1	4.2	2.9	3.7	4.4	4.4

Medications locations by distance (Note: Colors are used to help visually express the pattern of values, from red for long distances to green for short distances, and the same scale for low to high ratings).

TABLE 2

	Norton Brownsboro	Good Sam Puyallup 6	St. Charles Redmond	Harrison 2S (Med/Surg)	St. Charles 3 Ortho Unit	St. Charles 4 Medical Unit	Good Sam Puyallup 4	Emory Johns Creek Hosp.	Good Samaritan Corvallis	Harrison 2W (Oncology)	Prov Portland 8N (Ortho)	Prov Portland 8S (Neuro)	Samaritan Lebanon	Samaritan Albany
	Centralized serving 21+	Centralized lserving 21+ patients	Centralized serving 21+	Decentralized serving 11-20	Centralized serving 21+ patients	Centralized serving 21+ patients	Decentralized serving 11-20 patients	Decentralized serving 11-20	Decentralized serving 11-20	Decentralized l serving 11-20 patients	Decentralized serving 5-10 patients	Decentralized serving 5-10 patients	Corridor cabinet serving 1-4 patients	In pat room (nurse server) and central location
Beds /med rm	24	20	18	18	13	12.5	1	12	12	12	8.7	7.3	5.3	1.0
Time for care	3	4	3.8	2.4	3.6	3	3.3	3.9	2.9	3.3	3.9	4.1	4.3	3.9
Time for documentation	3.5	3.9	3.8	2.8	3.9	3.1	3.2	3.9	2.8	3.1	4	4.1	4	3.6
Patient Safety	3.9	3.9	4.2	3.5	3.9	3.1	2.8	4.1	2.9	3.3	4.1	4.4	3.7	4.4

Medications locations by number of patients per med room (Note: Colors are used to help visually express the pattern of values, from red for long distances to green for short distances, and the same scale for low to high ratings).

1. total amount of medication room area per unit expressed as square feet per bed
2. average medication room or space in square feet

In correlating square-foot area per bed, the relationship is quite consistent with safety scores. Refer to table 3. Highlighted in the table, units with the largest total size of med room space (7.8 square feet per bed and above) received very high ratings (3.9 and higher). Units with med rooms below that size all received scores of 3.5 or lower, with only one facility not fitting this pattern (Norton Brownsboro).

In correlating average square-foot area per med room, the relationship is again quite consistent with safety scores. Refer to table 4. As highlighted in the table, units with the largest average med room size (82 square feet per med room and above) received very high ratings (3.9 and higher).

Variables noted in nurses' comments which were taken into account in analyzing the data include the following:

- Often, medication administration requires visits to multiple locations. Supplies (i.e., IV tubing, syringes, etc.) are sometimes in a separate location from the medications. Not all medication rooms on a unit have the same stock, due to capacity limits. Pharmacy staff

TABLE 3

Unit	Tot size of all med rooms as sf/bed	Ave. safety score
Providence 8S	14.1	4.4
Providence 8N	12.6	4.1
Good Samaritan Puyallup 6	10.4	3.9
St Charles Bend 3	8.4	3.9
Emory Johns Creek	8.0	4.1
St Charles Redmond	7.8	4.2
St Charles Bend 4	7.1	3.1
Good Samaritan Corvallis	6.0	2.9
Good Samaritan Puyallup 4	5.9	2.8
Norton Brownsboro	5.8	3.9
Harrison West	3.3	3.3
Harrison South	2.1	3.5

TABLE 4

Unit	Ave. med rom size	Ave. safety score
Good Samaritan Puyallup 6	219	3.9
St Charles Redmond	140	4.2
Norton Brownsboro	140	3.9
Providence 8N	109	4.1
Providence 8S	103	4.4
Emory Johns Creek	96	4.1
St Charles Bend 3	82	3.9
Good Samaritan Corvallis	80	2.9
Good Samaritan Puyallup 4	71	2.8
St Charles Bend 4	57	3.1
Harrison West	36	3.3
Harrison South	36	3.5

often does not restock adequately. These problems usually result from undersized med rooms. This was taken into account by averaging the distance traveled to one or two med rooms in the percentage of times that the nurses stated that they needed to access two med rooms in table 1.

- Because medications are given at standard times, there is often a backup at med dispensers, especially in medical inpatient units, where more medications are involved.

Supplies

See table 5, which attempts to correlate the distance to the nurses' rating of the resource location's support of the three patient care goals (higher distance in feet, should equate to a lower time availability, while higher rating scores indicate more time for the nursing goals). Colors are used to help express visually the pattern of values, as with the medications data. The data shows that there is a partial correlation of travel distance to the nurses' ratings of support for the patient care goals. Approximately one-quarter of the units are outliers and do not correspond. The research team therefore concluded that other factors figure in the nurses' rating.

See table 6, which correlates type of decentralization (rather than distance) with the nurses' ratings (more centralized locations should equate to a lower time availability, while higher rating scores indicate more time for the nursing goals). Here there is a more compelling correlation, with only one outlier. Possibly there is a greater sense of control over the supply chain when it is more dedicated to a small neighborhood.

Below are variables noted in nurses' comments that were considered in analyzing the data:

- Supply centers often don't have comprehensive stock, or don't get restocked quickly, causing travel to more than one location. This was taken into account by averaging the distance traveled to one or two med rooms in the percentage of times that the nurses stated that they needed to access two supply rooms in table 5.

Equipment

See table 7, which correlates distance to nurse rating of the resource location's support of patient care goals (higher distance in feet should equate to a lower time availability, while higher rating scores indicate more time for the nursing goals). Colors are used to help express the pattern of values visually, as with the medications, supplies, and linen data. The data shows there is a poor correlation of travel distance to the nurses' ratings of support for the patient care goals. Therefore, the research team concluded that distance to the nearest equipment location is not a primary factor in the nurses' rating.

Refer to table 8, which correlates type of decentralization (regardless of distance) to the nurses' ratings (higher centralization should equate to a lower time availability, while higher rating scores indicate more time for the nursing goals). Here there is also a poor correlation.

Nurses' comments related to equipment:

- Equipment rooms are usually too small; therefore, equipment is placed in multiple locations, causing nurses to travel to multiple locations to find it.
- When decentralized equipment closets are used, the equipment isn't always returned to its rightful place, again causing nurses to hunt and gather. Central equipment rooms scored as well or better than decentralized locations, indicating that reliability of location is more important than distance.
- It was noted that the scores are relatively low in general, indicating that equipment gathering is a significant problem at most units.

Documentation (electronic medical record [EMR]) space

Research question: Is there a correlation between the different location types of documentation space (using EMR system), and nurses' perception of their impact on direct patient care time, documentation time, patient safety, and minimizing noise and distractions?

Below, survey results are summarized for ratings of four different patient care impacts based on type of location for the EMR.

<u>Impact on time for direct patient care</u>

All decentralized EMR locations were favored over centralized, with those closest to the patient favored the most. This seems logical since nurses can better observe patients when they're located closer to documentation activity.

An interesting finding emerged from this data. In patient rooms with fixed EMR, the average rating was 4.7 out of 5 (very high), while the average rating was 3.6 (considerably lower) in rooms where mobile EMR is used. We received comments that the mobile EMRs are cumbersome to move around, and we have heard this often outside of the study.

<u>Impact on time for documentation</u>

The corridor alcove was rated best, the satellite a close second best, the patient room third best, and the central location a distant fourth. Possible reasons for this rating include that it is preferable to be proximate to the patient, but slight separation from the patient and family increases concentration and efficiency when documenting.

TABLE 5

	Norton Brownsboro	Good Sam Puyallup 4	Emory Johns Creek Hosp.	Samaritan Lebanon	St. Charles 3 Ortho Unit	St. Charles 4 Medical Unit	Samaritan Albany	Harrison 2S (Med/Surg)	Harrison 2W (Oncology)	Good Samaritan Corvallis	Prov Portland 8S (Neuro)	Prov Portland 8N (Ortho)	Good Sam Puyallup 6	St. Charles Redmond
	Centralized serving 21+	Centralized serving 21+ patients	Decentralized serving 11-20	Decentralized serving 11-20	In patient room (nurse server),	In patient room (nurse server), central	In patient room (nurse server)	Centralized serving 21+ patients	Decentralized serving 11-20 patients	Decentralized serving 11-20	Decentralized serving 5-10 patients	Decentralized serving 5-10 patients	Central location serving 21+	Corridor cabinet serving 1-4 patients
Avg. dist to other loc	na	113	na	91	40	40	35	na	na	na	36	32	1	13
Avg. dist to closest loc	82	37	40	17	3.5	0	32.3	29	28.4	26	0	0	28.4	0
Avg dist to combined locs	82	75	40	39.2	38.2	38	33.6	29	28.4	26	14.4	12.8	11.96	6.5
Time for care	3	1.7	4	3.4	3.5	3	3.8	2.9	2.8	2.6	3.7	4.1	3.7	4
Time for documentation	3.1	2.2	4	3.4	3.5	3.3	3.6	2.8	2.9	2.6	3.7	3.9	3.6	3.8
Patient Safety	3.6	1.8	4.1	3.4	3.4	3.1	3.8	2.9	3	2.7	3.7	4.1	3.4	4

Supply locations by distance (Note: Colors are used to help express the pattern of values visually, from red for long distances to green for short distances, and the same scale for low to high ratings).

TABLE 6

	Good Sam Puyallup 4	Norton Brownsboro	Harrison 2S (Med/Surg)	St. Charles 3 Ortho Unit	St. Charles 4 Medical Unit	Samaritan Lebanon	Harrison 2W (Oncology)	Good Samaritan Corvallis	Emory Johns Creek Hosp.	Prov Portland 8N (Ortho)	Prov Portland 8S (Neuro)	Good Sam Puyallup 6	St. Charles Redmond	Samaritan Albany
	Centralized serving 21+ patients	Centralized serving 21+	Centralized serving 21+ patients	Centralized serving 21+ patients	Centralized serving 21+ patients	Decentralized serving 11-20 patients	Decentralized serving 11-20 patients	Decentralized serving 11-20	Decentralized serving 11-20	Decentralized serving 5-10	Decentralized serving 5-10	Patient room	Corridor cabinet serving 1-4	In patient room (nurse server)
Type: central vs decent	4	4	4	4	4	3	3	3	3	2	2	1	1	1
Time for care	1.7	3	2.9	3.5	3	3.4	2.8	2.6	4	4.1	3.7	3.7	4	3.8
Time for documentation	2.2	3.1	2.8	3.5	3.3	3.4	2.9	2.6	4	3.9	3.7	3.6	3.8	3.6
Patient Safety	1.8	3.6	2.9	3.4	3.1	3.4	3	2.7	4.1	4.1	3.7	3.4	4	3.8

Supply locations by type (Note: Colors are used to help express the pattern of values visually, from red for long distances to green for short distances, and the same scale for low to high ratings).

TABLE 7

	Emory Johns Creek Hosp.	St. Charles Redmond	Samaritan Lebanon	St. Charles 3 Ortho Unit	Good Sam Puyallup 4	Prov Portland 8S (Neuro)	Harrison 2W (Oncology)	Norton Brownsboro	St. Charles 4 Medical Unit	Good Sam Puyallup 6	Good Samaritan Corvallis	Prov Portland 8N (Ortho)	Samaritan Albany	Harrison 2S (Med/Surg)
	Centralized serving 21+ patients	Central serving 21+	Decentralized serving 11-20 patients	Centralized serving 21+	Central ized serving 21+	Centralized serving 21+	Central location serving 21+	Decentralized serving 11-20	Centralized serving 21+	Central location serving 21+	Decentralized serving 11-20	Decentralized serving 11-20	Centralized serving 21+	Central location serving 21+
Ave distance	105.6	86	75.2	70	64	62	54.7	54.4	50	41.6	40.1	28.3	28	23
Time for care	3.4	3.3	3.1	3.4	2.3	3.9	2.9	3.4	2.3	3.3	2.5	3.1	3.4	3
Time for documentation	3.4	3.3	3.3	3.4	2.3	3.6	3.3	3.3	2.4	3.3	2.7	3	3.5	3.1
Patient Safety	3.4	3.5	3.3	3.3	2.3	3.7	3	3.5	2.9	3.6	2.7	3.3	3.4	2.9

Equipment locations by distance (Note: Colors are used to help visually express the pattern of values, from red for long distances to green for short distances, and the same scale for low to high ratings).

TABLE 8

	Harrison 2W (Oncology)	Harrison 2S (Med/Surg)	Samaritan Albany	Prov Portland 8S (Neuro)	St. Charles 3 Ortho Unit	St. Charles 4 Medical Unit	Good Sam Puyallup 6	Emory Johns Creek Hosp.	Good Sam Puyallup 4	St. Charles Redmond	Good Samaritan	Prov Portland 8N (Ortho)	Norton Brownsboro	Samaritan Lebanon
	Centralized serving 21+	Central location serving 21+ patients	Centralized serving 21+ patients	Centralized serving 21+ patients	Centralized serving 21+ patients	Centralized serving 21+ patients	Centralized serving 21+ patients	Centralized serving 21+ patients	Central ized serving 21+ patients	Centralized serving 21+ patients	Decentralized serving 11-20	Decentralized serving 11-20	Decentralized serving 11-20	Decentralized location serving 11-20 patients
Type of decentralization	1	1	1	1	1	1	1	1	1	1	2	2	2	2
Time for care	2.9	3	3.4	3.9	3.4	2.3	3.3	3.4	2.3	3.3	2	3.1	3.4	3.1
Time for documentation	3.3	3.1	3.5	3.6	3.4	2.4	3.3	3.4	2.3	3.3	2.3	3	3.3	3.3
Patient Safety	3	2.9	3.4	3.7	3.3	2.9	3.6	3.4	2.3	3.5	2.3	3.3	3.5	3.3

Equipment locations by type (Note: Colors are used to help express the pattern of values visually, from red for long distances to green for short distances, and the same scale for low to high ratings).

Impact on patient safety

The patient room location is significantly favored for safety, with corridor alcoves and satellites moderately rated, and centralized locations a distant fourth. This suggests that more time spent in or near the patient room enhances patient observation and safety.

Minimizing noise and distractions

The patient room location and corridor alcoves were favored for noise and distraction reduction, with satellites getting a moderate rating and centralized locations a distant fourth. Fewer people are present at any of the decentralized locations, creating less noise and distraction. For years, nurses have complained about the difficulty of concentrating at central nurse stations

Correlation with unit configuration

The research team sought to find design configuration correspondence within the data, as follows.

Satellite EMR locations:

- For satellites that are open visually to corridor space, five of six were rated positively (above 3.0) for patient safety. The average score was 3.4 out of possible 55. It is common for nurses to request visual access to the corridor to monitor patient activity, family and staff members seeking assistance, and to hear patient distress signals. The correlation corroborates this. Predictably, these same units received low scores for minimizing noise and distraction (only two of four positive, and average of 3.1). Intuition would tell us that the openness would invite distractions, and the data corroborates this. This poses a design challenge.
- There was no significant difference in ratings related to the number of patients served from that location.
- There was no significant difference in ratings related to average distance to patients served from that location.
- There was no significant difference in ratings in safety related to visibility of corridors from the satellite work station.

Corridor alcoves:

- For corridor alcoves that are open visually to corridor space, five of six were rated positively (above 3.0) for patient safety. The average score was 3.6 out of 5. Interestingly, these same units received high scores for minimizing noise and distraction (five of six positive, and average score of 3.4 of a possible 5). Intuition would tell us that the openness would invite distractions, but the data does not corroborate this.
- There was no correlation between size of worktop, or design of the alcove to the rating of the factors requested. Some alcoves have built-in desks; some are merely spaces for mobiles.

Centralized EMR locations:

- Only 3 of the 14 units have a central location to chart. All these units were rated with low scores. This reflects a current trend to eliminate central work areas for staff. All three also have EMR in patient rooms. Predictably, one of the three units with central EMR also has placed some computers in corridor alcoves, and although not done in a systematic consistent way, this unit's nurses rated all categories of questions higher (ranging from 0.5 to 1.0 higher in the four categories).

Collaboration space

Research question: Are certain types of collaboration spaces (central, satellite, corridor alcove, patient room) more effective than others?

Survey

Nurses were surveyed for the following:

- For each of four types of collaboration (informal, formal, shift change reporting, and physician consultation), indicate where it most often occurs. Options included patient room, corridor alcove, satellite, or centralized.
- For each type of collaboration, indicate its effectiveness (scale of 1 to 5 from "not at all effective" to "very effective").

Notes on correlation to location

Informal:

- All units averaged moderately high scores for effectiveness. All ratings were above 3.1 (positive), and 12 of 14 were 3.5 or above (between neutral and somewhat effective).
- There is no correlation of scoring to average distance from the stated location to patient. The average distance between bed and collaboration location ranged from 6 to 42 feet
- Ratings of the different locations where informal collaboration occurs were not consistently better for any one type over another. This contradicts findings in studies cited previously in this paper that show reduced communications in decentralized nurse stations, possibly because nurses are adapting to decentralization and possibly because the unique design elements are influencing the responses.

Formal care planning meetings:

- All units averaged moderately high scores for effectiveness. All ratings were 3.4 or higher (between neutral and somewhat effective).
- There is no correlation of scoring to average distance from the stated location to patient. Average distance between bed and formal collaboration location ranged from 13 to 180 feet.
- Twelve of the 14 units use a large room on the unit. For these units, there is only one place where this occurs, and as distance was not a factor in favoring shorter average walking distances, one can conclude that this room can be anywhere on the unit—preferably at the edge of the unit, to preserve valuable central real estate for other spaces.

Shift change reporting:

- All units averaged moderately high scores for effectiveness. All ratings were 3.2 or above (between neutral and somewhat effective).
- There is no correlation of scoring to average distance from the stated location to patient.
- Thirteen of 14 occur at a very decentralized location (8 at corridor alcove, 4 at patient room and 1 at satellite). This indicates a strong arrival at true decentralization of activity enabled by EMR.
- Ratings indicate no preference of one type of location over the other.

Physician consultation:

- All units averaged moderately high scores for effectiveness. All ratings were 3.2 or above (between neutral and somewhat effective).
- There is no correlation of scoring to average distance, which ranges from 0 to 180 feet, from the stated locations to patient.
- Ten out of 14 occur at a decentralized location, regardless of type of physician work space in the unit.
- Ratings indicate no preference of one type of location over the other.

Conclusions

Medications and related supplies for administering medications

The reduction of the distance between medication storage space and the patient is valuable in supporting nurses' direct patient care time, documentation time, and safety, but not the only strategy that matters. The number of patients per med room did not correlate to support for patient care goals. The medications space must be adequately sized so that all medications and related supplies can be in a single location, so nurses don't have to walk to multiple locations, which is time consuming and demoralizing. Pharmacy staff must maintain stock for decentralization to succeed.

The size of the med room has a significant impact on nurses' perception of patient safety, as shown by nurses' ratings that larger rooms and more area per bed are better for this factor.

Medical supplies

Reducing walking distance between supply storage and the patient is valuable in supporting nurses' direct patient care time, documentation time and safety, but it's not the only strategy that matters. Decentralization itself may be important, creating zones of control for nurses. The supply space must be adequately sized so all medications and related supplies can be in a single location, so nurses don't have to walk to multiple locations, which is time-consuming and demoralizing. Maintaining par stock by materials management staff is critical to success.

Equipment

The reduction of walking distance between equipment storage and the patient did not correlate to increasing nurses' direct patient care time, documentation time, and safety. This is because when equipment is decentralized, items are not returned to a given location and cannot be found reliably. This causes nurses to hunt for the item frequently in multiple locations. In this survey, single centralized rooms were rated similarly as decentralized rooms, possibly indicating that a shorter walking distance to the nearest decentralized location is offset by the frequent need to go to another equipment room. This research calls for further study to analyze which equipment should be at what level of decentralization in-room, satellite, or central. A lean process would provide an opportunity to develop a strategy, even though strategies would be different for different specializations of care (ortho, cardio, medical, oncology, etc.).

Electronic medical record (EMR) space

1. Time for direct patient care: Satellites scored highest, patient room second, and corridor alcoves third. Fixed EMR workstations scored significantly higher than mobile workstations in increasing direct patient care time. Comments from nurses noted several problems with mobile EMR (infection control, cumbersome carts, inability to carry other things when moving with EMR device).
2. Time for documentation: Corridor alcoves scored highest, satellites a very close second, and patient rooms third. This is possibly because it is preferable to be close to a patient, but slight separation from the patient and family reduces distractions when documenting.
3. Patient safety: Patient room location scored highest, corridor alcoves a very close second, and satellite third. A possible reason is that spending more time in or near the patient room enhances patient observation, and therefore, safety.
4. Minimizing noise and distractions: Patient room location scored highest, corridor alcoves a very close second, and satellite third.
5. Other factors:

   a. Corridor alcoves and satellites with open visibility are preferable to ones without for increased patient safety. However, noise and distraction are a problem with the satellites, but not for the corridor alcoves, possibly due to less crowding because there are more of these allowing the care team to spread out.
   b. Size at these decentralized locations is often inadequate. Further study is needed to determine optimum size.

Collaboration space

1. Informal collaboration: Almost all collaboration occurs at decentralized locations, and in terms of effectiveness, neither type of location (corridor alcove or satellite) is preferred consistently. The average distance to a patient does not matter in this study.
2. Formal care planning meetings: Distance does not affect effectiveness. Therefore, one can conclude that this room can be anywhere on the unit—preferably at the edge of the unit to preserve valuable central real estate for other uses.
3. Shift change reporting: Almost all occurs at decentralized locations, and in terms of effectiveness, none of the location types (patient room, corridor alcove, or satellite) are preferable consistently. The average distance to a patient does not indicate preference of one type.
4. Physician consulting: In two-thirds of units, consulting occurred at decentralized locations and one-third at central locations. In terms of effectiveness, none of the location types (patient room, corridor alcove, satellite, or central location) are preferable consistently. The average distance to a patient does not indicate preference of one type.

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Applying Maslow's Hierarchy of Needs to Human-Centered Design Translating HCAHPS Results into Designs that Support Improved Care Delivery

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ABSTRACT

In this paper, we apply Abraham Maslow's hierarchy of needs to the hospital setting to offer insights to health care organizations seeking to improve their Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey results. Positive survey results have a direct financial impact on hospitals; the Patient Protection and Affordable Care Act of 2010 ties their value-based incentive payments to their HCAHPS scores.

The HCAHPS survey contains two questions that relate directly to a hospital's physical environment. All remaining questions require patients to assess the quality of the care provided by caregivers—doctors, nurses, and hospital staff. The survey thus presents a difficult challenge to healthcare administrators and architects working on new construction or renovation projects: How to translate the information gleaned from these surveys into designs that facilitate improvements in healthcare delivery—and thus, better survey results.

As a conceptual response, we propose a "human-centered design hierarchy of needs," based on Maslow's hierarchy of needs, as a way to conceptualize a hospital stay and illuminate ways in which healthcare facility design can support more responsive patient care delivery.

We conclude that facility design provides an essential foundation for the delivery of excellent patient care, which, in turn, supports the optimal patient experience. We also conclude that a lean design that promotes staff efficiency by locating support spaces and staff and physician work areas near patient rooms on inpatient care units supports improvements in both the efficiency and the efficacy of care.

Introduction

The challenge: Translating HCAHPS results into designs that supports improved care delivery

Starting in 1943, psychologist Abraham Maslow identified a hierarchy of needs common to all people in his seminal paper, "A Theory of Human Motivation" (Maslow, 1943). Maslow's theory of what motivates people is commonly presented as a pyramid, with basic physiological needs as the bottom layer, safety and security as the second layer, and positive social contact with others—belonging to a family and a broader social group—as the third layer. Each layer is necessary to support the layer above it. The bottom three layers provide the foundation for the top two tiers of Maslow's pyramid: Enabling people to lead meaningful, fulfilling lives.

In this paper, we apply Maslow's hierarchy of needs to the hospital setting as a way to support healthcare organizations as they seek to improve their Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey (Appendix 1) results. Hospitals and health systems are paying more attention to these scores as a result of the Patient Protection and Affordable Care Act of 2010, which—since 2012—has tied hospitals' value-based incentive payments to their HCAHPS scores on patient experience (See Appendix 2).

The HCAHPS Survey contains 21 areas where patients are asked to offer their perspectives on nine key elements:

1. communication with doctors
2. communication with nurse
3. responsiveness of hospital staff
4. pain management
5. communication about medications
6. discharge information
7. cleanliness
8. quietness
9. transition of care

Patients are asked the following:

- Did doctors and nurses treat them with courtesy and respect?
- Did these caregivers listen to them carefully?
- How quickly did nurses respond to call buttons?
- Did hospital staff do "everything they could" to help with pain?
- Did they explain for which purpose medications were administered and their potential side effects?
- Did patients understand their needs for follow-up care after their hospital stay before they left the hospital?

FIGURE 1

Image credit: J. Todd Robinson, AIA, ESa

At the survey's end, patients rate the hospital on a scale that goes from "worst hospital possible" to "best hospital possible."

Although the physical environment may have an impact on many areas of the survey, only two HCAHPS survey questions relate directly to the hospital environment:

- How often were your room and bathroom kept clean?
- How often was the area around your room quiet at night?

Both questions address issues where facility design can have a positive impact on a patient's experience. State-of-the-art healthcare designs now facilitate infection control and thorough, attentive housekeeping by avoiding the creation of spaces that are difficult to reach. Special consideration is given to selection of materials used on floors, walls, and other surfaces for durability, dirt- and bacteria-resistance, and ease of cleaning and maintenance. Proper soundproofing, which supports patient privacy, is also integral to modern healthcare design, dictated the use of materials that absorb rather than amplify noise wherever possible. Acoustic design that controls noise also improves communication among caregivers and between caregivers and patients, who are more likely to hear, understand, and respond to questions and directions if they aren't distracted by noise.

The remaining HCAHPS questions require patients to assess the quality of the care provided by caregivers—doctors, nurses and hospital staff. They are specific to respectful and responsive care delivery and address details such as timely response to call buttons, timely assistance in toileting, clear and courteous communication about medications, and appropriate pain management.

The HCAHPS questionnaire presents a challenge to healthcare administrators and architects working together on new construction or renovation projects: How do you translate the information gleaned from these surveys into designs that facilitate improvements in healthcare delivery by doctors, nurses and other hospital staff—and thus, better survey results?

We propose to use Maslow's hierarchy of needs as a means of conceptualizing a hospital stay to illuminate ways in which healthcare facility design can support more responsive delivery of patient care.

This paper is directed at an audience familiar with the healthcare environment. Using Maslow's hierarchy of needs, we will approach that environment from the perspective of adult patients experiencing their first hospital stay.

For our patient, Adam, the hospital is completely unfamiliar. Though he has probably seen hospital dramas on television, those may have given him an inaccurate impression that doctors and nurse spend hours in patients' rooms.

At home, he controlled his schedule. In the hospital, his schedule is controlled by others and is based on his treatment plan. He may have lost his freedom to choose what to eat and when. Whether he is allowed to choose his meals and meal times, his meal deliveries may be timed to accommodate scheduled tests or procedures.

Adam may or may not have chosen his doctor(s), and he certainly hasn't selected his nurses. And though they may be helping him with intimate tasks such as bathing and toileting, he is very likely meeting them for the first time—and in a hospital robe or pajamas—not attire anyone would choose for meeting strangers. He is aware that recovery, and perhaps his life, depends on their care.

Finally, the patient is in a strange place where he no longer controls many aspects of his life, but is there because he is sick or injured or, perhaps, dealing with a recently-diagnosed chronic health issue.

As Adam enters the hospital for his stay, his immediate environment makes an indelible first impression that will very likely influence his answers to the HCAHPS Survey he will complete after his discharge. This environment includes the following:

- the entry drive and approach to the hospital campus
- exterior signage
- the grounds and landscaping
- the hospital entrance and public areas
- the appearance of the inpatient unit to which patient is admitted
- the patient room

In this paper, we also propose a corresponding hierarchy of needs similar to Maslow's—one that supports human-centered design—and design principles to show various ways in which layout, materials, and infrastructure can facilitate patient-preferred practices. This requires the transformation of inwardly focused organizational cultures (which may have been provider-focused in the past) to cultures where each patient's experience becomes and remains a top priority.

We want to stress that patient-centered design and care delivery need not come at the expense of efficiencies such as building layouts that place doctors and nurses near patients and reduce time spent walking hospital corridors. Rather, we contend that patient-centered design, that supports the goal of maximizing the time clinical teams can spend attending to patients' needs, also promotes efficient use of caregivers' time.

A lean design that promotes staff efficiency by locating support spaces, staff, and physician work areas near patient rooms on inpatient care units increases the time the clinical team can spend at a patient's bedside and on other patient care tasks. For hospitals, lean design aims to create an environment supportive of both the efficiency and the efficacy of care (Miller et al., 2012).

FIGURE 2

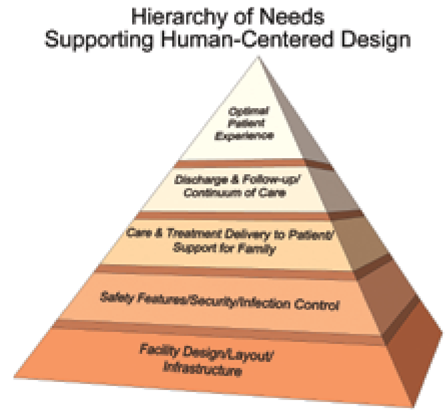

Image credit: J. Todd Robinson, AIA, ESa

Tier 1. The bottom of the pyramid: Physiological needs/ facility design, layout & infrastructure

At the bottom of Maslow's hierarchy of needs are the basic requirements for human physical survival: air, water, clothing, shelter, nourishing food, and adequate rest. These requirements are essential to sustain life and underscore the importance of the physical plant and infrastructure at all types of health care facilities, where the aim also is to sustain life.

At the base of our patient-experience hierarchy of needs pyramid is the physical building and infrastructure, with the following essential elements to meet patients' physiological needs and create a healing environment:

- Natural light in public areas and in patient rooms
  - Natural light helps keep patients oriented to circadian rhythms. Research has demonstrated that natural light has a positive impact on improved sleep, pain control, patient stress, and depression (Boyce et al., 2006) (Joseph, 2003). It is also one of the most comforting and familiar things hospitals can provide their patients.
  - It also benefits staff. Nurses exposed to exterior nature views and natural light report improved alertness and reduced stress, and a recent study indicates physiological benefits. Natural light has a positive impact on staff satisfaction and decreases staff stress (Sadeh et al., 2014).
- Private patient rooms to promote a healing environment
  - Private rooms support infection control, reduce instances of hospital acquired infections (HAIs) (Ulrich et al., 2008) reduce noise and stress (Reiling et al., 2008), and provide patients with their own space in an unfamiliar place.
  - Private patient rooms have been shown to reduce patient falls and medical errors (Gallant and Lanning, 2001).
  - Multiple studies demonstrate patients' needs for privacy and control over their environment.
  - Private rooms afford patients desired privacy and control, which translates to more favorable scores on the HCAHPS survey (Knutt, 2005).
  - Patients perceive a private room as being cleaner and less noisy (Cullinan and Wolf, 2010).
  - Private rooms are more conducive to the involvement of family, friends, and partners in the care experience and have a positive effect on patient satisfaction (Reiling et.al, 2008).
  - Private rooms provide a more homelike and welcoming setting.
- Ample, accessible public and family areas
  - Many patients will have family members who remain with them for the duration of their stay, which is now encouraged based on evidence showing the benefits of the presence of family members on communication, decision making, and patient care during hospitalization and outpatient procedures (AACN Practice Alert, 2016).
  - Meeting the physiological needs of family members who are supporting patients during their stay and will likely assist with follow-up care is as important as meeting the patient's own physiological needs.

- Effective air-handling systems that control temperature appropriately, eliminate odors, and provide adequate air exchanges to support infection control
  - Rooms should be equipped with accessible controls that allow the patient and/or staff to maintain the room at a temperature that's comfortable for the patient.
- Use of acoustic design and sound-absorbent materials to reduce or eliminate noises that disrupt rest and sleep
  - High sound levels in healthcare settings increase patient and staff stress.
  - A quiet hospital environment is one of nine areas included in the HCAHPS survey.
  - Acoustic ceiling tiles have been shown to be a cost-effective solution to noise abatement, whereas hard ceilings increase noise level (Frederick et al., 2012).
- A state-of-the-art kitchen and meal delivery system that makes it easy for patients who can choose their own meals to do so and provides nourishment for family and caregivers
  - Availability of nourishment on the patient unit so patients aren't dependent solely on meal delivery.
- Bathrooms that accommodate patients and family members of all shapes and sizes, which can be quickly and easily cleaned and disinfected
- Ample warm (rather than cool) lighting in all areas
  - Hospital corridors and work areas must be well-lit.
  - Warm light in corridors, patient rooms, and treatment rooms creates a more home-like, less institutional atmosphere.

Adam, our adult patient, may enter the hospital for his treatment through the emergency room, through the front entrance via a pre-arranged appointment, or from a physician's office in an attached medical tower. He may be walking, in a wheelchair, or on a stretcher. If he is awake and cognizant, the first part of his patient care experience will involve his impression of public spaces, corridors, elevators, the room he will occupy during his stay, any noises he hears, and any odors he smells.

Adam has a good experience: He doesn't have to wait to enter his room, and the care team greets him by name. Although he has heard that hospital staff repeatedly ask patients the same questions, his care team already has his personal health information, which he and his doctors provided electronically before his admission. Once checked into his private room, he has a room of his own. Though caregivers will be monitoring him, he can close the door of his room if he wishes. He controls his privacy.

The hospital remains an unfamiliar space, but the room where Adam will spend his stay is clean, cheerful, well-lit, and quiet. His room includes a wardrobe, a writing desk, and storage for his personal belongings. His bed is angled toward the window for views to the outside and access to natural light.

There is a comfortable chair for his wife, and the admitting nurse mentions the availability of a sleeper if she wishes to stay overnight. The family space provided in his room ensures his children don't have to wait in the corridor and also benefits staff by helping keep halls clear of visitors, so staff can move freely through the corridors.

If Adam is able to eat, he is presented a menu and invited to order his own meals. The nurse mentions a nourishment area on the unit that is available to patients and family members and a cafe located near other family amenities. The bathroom is obviously designed to accommodate people with severe physical challenges, but it is sparking clean and accessible. Adam's concerns about "that hospital smell" evaporate.

Adam's basic physiological needs are met with a design that also meets the needs of the doctors, nurses, and other staff who will provide his care. His inpatient unit and room are both laid out to align with the work patterns of the doctors, nurses, and other staff members who will be caring for him. Because his unit includes decentralized work stations, the nurse assigned to him is nearer his room where she can observe him more easily and reach his room in less time. A standardized room design helps staff avoid wasting valuable time searching for equipment, supplies, or electrical outlets. Patient rooms are equipped with standardized headwalls and laid out so as to save staff steps. Charting accommodations are planned at the bedside to support real-time documentation and avoid charting errors.

Adam can't see them, but the building's systems are well-maintained and efficient. A central energy plant and its systems support the delivery of heated or cooled air to the entire facility. Ample natural light, which benefits staff as well as patients, streams through energy-efficient glass. Acoustical tiles in the ceiling and soundproofing in the walls absorb the sound of Adam's flat-screen television and of his visitors so the patient sleeping in the next room is not disturbed. The soundproofing in his and other patient rooms also helps nurses preparing medication for patients to focus on their work without distraction.

In addition to meeting Adam's basic physiological needs, his room may have some pleasing modern features that his room at home lacks, such as LED lighting with control options for him and his family, and modular furniture with built-in features to accommodate his needs and those of his family.

The leadership team of the hospital where Adam will be treated has been very intentional about providing a healing environment, down to the last detail, while also supporting staffing and workflow efficiencies through lean design concepts.

Tier 2. Safety & security: Patient-care priorities

In May 2016, patient safety experts at Johns Hopkins University School of Medicine released the results of an eight-year study indicating that more than 250,000 deaths per year can be attributed to medical error, which the study defines as "an unintended act (either of omission or commission) or one that does not achieve its intended outcome; the failure of a planned action to be completed as intended (an error of execution); the use of a wrong plan to achieve an aim (an error in planning), or a deviation from the process of care that may or may not cause harm to the patient" (Makary and Daniel, 2016). The study notes that "Patient harm from medical error can occur at the individual or system level" (Ibid).

Adam, our hospital patient, saw a news report about this study on television and is understandably concerned about medical errors and hospital-acquired infections such as MRSA. Adam is less aware of many other patient safety issues, such as falls, and he may not realize the materials used on the ceilings, walls, and floors of his room, the corridors and various treatment areas promote his safety and the safety of his caregivers by aiding in the prevention and reduction of falls and supporting infection control.

A patient-centered hospital integrates these safety features into its design:

- Avoiding small, inaccessible spaces that are difficult to clean and disinfect to support both infection control and efficient use of staff resources
- Use of non-porous, bacteria-resistant materials on walls, floors and counters to support infection control
- Ample storage for equipment and supplies to eliminate clutter in patient rooms and hallways, reducing instances of clutter-related accidents and supporting cleanliness and infection control
- Smooth floor transitions to help avoid trip hazards and prevent falls
- Ceiling-mounted lifts for patient and staff safety when transferring non-ambulatory patients
    - Patient lifts are becoming a necessity to support staff and patient safety during transfers (Assoc. of Occupational Health Professionals, 2014).
    - Numerous studies indicate that facilities that install patient lifts in rooms significantly reduce staff injuries and missed staff days due to injury (Alamgir et al., 2009).
    - As of 2011, fewer than 20% of new projects included lifts (Washington Dept. of Labor and Industries SHARP Program, 2011).
- Adequate space on all sides of the bed for caregivers to gain access to and assist patients
- Sinks that remind staff to wash their hands
    - Some healthcare organizations have embraced the use of hand-hygiene compliance monitoring (HHCM) systems to monitor and impact change in caregiver hand washing behavior (Lorenzi, 2014).
- Visual cues to guide patients to the sink and the bathroom
    - These cues may involve stripes on the floor and/or low-level lighting.
- Well-lit work areas and work surfaces to reduce medication and documentation errors
- Wireless bedside technology for monitoring patient vitals
- Decentralized work stations make it easier for nurses to observe and check on patients
- Convenient access to medications in distraction-free areas to reduce the potential for medication errors
    - Pain management is one of the nine key areas addressed in the HCAHPS survey.
- Separation of public flow from the flow of patients, supplies, and materials
    - Providing separate travel paths for clean and dirty materials through an on stage/off stage design concept supports infection control principles and safe transport of people and materials
- Clear and consistent signage to support ease of wayfinding and avoid the waste of movement and time spent searching for one's destination
- Strategic use of art to serve as navigational landmarks for patients and visitors and support wayfinding, which has the added benefit of making the hospital environment more inviting and hospitable

All of these features support the hospital's rigorous infection, quality, and risk management programs. The hospital is taking careful steps to create a safe environment for Adam, its patients, staff, and visitors, while also reducing the number of steps that doctors and nurses must take to deliver attentive care.

Tier 3. Connecting with the patient and keeping him connected: Belonging

The "belonging" level of Maslow's hierarchy addresses the need all people have for social interaction, family connections, and belonging. Our corresponding tier addresses a patient's experience with all caregivers.

A well-designed facility with safety features that support a reduction in the number of medical errors and promotes patient safety only sets that stage. Patients' interactions with caregivers will determine their perception of their hospital stay. How patients perceive the quality of the care they received and whether they felt they were treated with respect and listened to is thus the major focus of the HCAHPS survey.

Our corresponding tier focuses on how design can have a positive impact on the interactions of caregivers with patients. A major goal is to maximize time available to caregivers to interact with patients by eliminating unnecessary steps, providing efficient workspaces located near patient care areas, and standardizing work and storage areas:

- Efficient department layouts to reduce the number of steps required to reach patients and attend to their needs
- Standardized space design to avoid wasted time when staff members must orient themselves to different room layouts, including supply rooms, support areas, treatment and patient rooms
  - Standardized patient room designs also improve the experience of patients who must move from one room to another, as the new room is still familiar.
- Standardized headwalls to facilitate multiple forms of patient care
  - Both space limitations and evidence-based design point to the benefits of designs that maximize adaptability of inpatient rooms as a long-term solution for responding to evolving technologies and treatments.
- Alignment of inpatient units with physician medical practices maximize the time physicians have to devote to patient care
- Wireless internet access in patient rooms and staff work areas
  - Most patients will bring laptops, tablets, and/or smartphones when they enter the hospitals.
  - Family members will also bring these devices; some may need to work from their family member's bedside.
- Accessible, adjacent parking for doctors and staff
  - Parking that doesn't require doctors and hospital staff to walk a long distance sends the message that the hospital values doctors and employees' time and their role in a patient's recovery.
- Thoughtful use of the arts throughout the hospital to promote healing (Arts in Healthcare, 2009)
  - The arts have been shown to have a positive impact on patient health outcomes, reduce stress and anxiety, and decrease perception of pain—a focus of the HCAHPS survey, which asks patients to evaluate whether their pain was controlled and if hospital staff did "everything they could" to help with pain.
  - Art in patient rooms and public areas has a civilizing influence; it also increases patient compliance with recommended treatments and reduces use of pain medications.
  - The arts also increase a sense of well-being and reduce stress for caregivers.
  - Reduced stress and a higher sense of well-being enhance the patient experience.
  - Reduced staff stress translates to fewer medical errors, higher job satisfaction, and enhanced patient safety.

Adam's hospital stay is an anomaly for him—a sharp break from the familiar daily routines of his life. Contact with his wife and children, friends, and other visitors reinforces his sense of belonging and thus his sense of well-being. Isolation accomplishes the opposite. Rooms that—in addition to providing a comfortable, safe and secure environment for the patients—also provide comfortable accommodations for family and visitors (including comfortable chairs and sleeping accommodations for overnight stays) send a powerful message about the importance hospital management places on enabling the patient to maintain his connections with family, friends, and the outside world.

Attractive, comfortable public areas where families and friends can gather also support the patient's sense of belonging. Several visitors have commented on the interesting visual art throughout the healthcare campus, opportunities to hear music and live performances, access to a valet for convenient access to the main entrance, retail options provided on the main level, and the comfortable and pleasing aesthetics of the hospital environment.

These design elements (along with accessible, secure, well-lit parking that doesn't require visitors to walk a long distance each time they visit the patient) sends a powerful message that the hospital values their time, their presence, and their role in a patient's recovery.

Adam's wife spends two nights in the hospital with him on comfortable sleeping accommodations. His room is large enough, so his family doesn't feel crowded and uncomfortable when his children visit. The hospital's well-maintained wireless network allows Adam and his wife to use their laptops to work, read the newspaper online, and talk to family and friends via Skype. Neither feels isolated or as if they've lost touch with their work colleagues, family, and friends.

Tiers 4 & 5. The top-tier goals: Fewer readmissions, better outcomes

The top two tiers of Maslow's hierarchy of needs address personal accomplishment and the achievement of one's potential. Our corresponding tiers are patient discharge—the patient has recovered sufficiently that he no longer needs acute care—and follow-up. The four lower tiers of our hospital hierarchy of needs include a well-designed environment; safety features, security and infection control; patient care delivery that integrates and accommodates family members; and discharge and follow-up. All tiers combine to support the optimal patient care experience.

In addition to addressing the patient's experience during his treatment, the HCAHPS survey addresses follow-up instructions:

- Did the patient receive them?
- Were the instructions clear?
- Did doctors and nurses explain any help the patient would need after leaving the hospital?
- Did they ask whether that help was available?
- Did they offer written information about symptoms or health problems to look for after leaving the hospitals?

When Adam is discharged, the nurse reviews the follow-up care he will need, including appointments with his doctor and physical therapist, medications, and the duration of his recovery at home before he returns to work. He learns that his follow-up visit with the physician can be done via the health system's telehealth portal, which allows Adam to communicate directly with his doctor without having to travel to the medical center, and thus missing another day of work. As he leaves the hospital, he is surprised: An experience he had feared would be isolating, alienating, inconvenient and uncomfortable—a three-day hospitalization—has been much more positive than he expected.

Conclusion

The design of a healthcare campus and the spaces within its facilities makes a crucial first impression on patients and sets the tone for the patient care experience. The hospital's safety, risk management, and infection control programs are also vital to protecting the patient from acquiring HAIs or being injured during his stay.

An attractive and efficient layout of patient care spaces aligned with caregiver workspaces supports and facilitates attentive care from doctors, nurses, and other members of the healthcare team. By fully addressing the first tier and supporting the priorities of the second and third tiers, facility design provides an essential foundation for the delivery of excellent care, which in turn supports the optimal patient experience.

Appendices

Appendix 1: HCAHPS Survey PDF

Appendix 2: HCAHPS Faculty Sheet PDF

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The Decentralized Station: More Than Just Patient Visibility

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ABSTRACT

Since the landmark study in 2004 by (Hendrich et al., 2004) investigating the impacts of patient visibility on reductions in morbidity of patients, healthcare designers, clinicians, and regulatory agencies have embraced the importance of patient visibility, particularly in the critical care environment.

The decentralized station was a physical change in patient units to move care to the bedside, while creating a space for staff and increasing the visibility of the most critically ill patients. This increase in patient visibility for critical care units is now part of the FGI Guidelines and code mandated in many states.

What began as a trend for the patients in the critical care environment is more recently expanding to medical / surgical patient care spaces. Little research has investigated the impact of the decentralized station on staff workflow and the design of the medical/surgical environment, and specifically the effects beyond patient visibility. To explore the impact of the decentralized station on the medical/surgical environment, the team conducted a post occupancy evaluation (POE) of the Penn Medicine Chester County Hospital.

The team found dramatic impact on staff travel distances, time spent providing patient care, and patients' overall perceptions of quality of care all of which positively aligned with the presence of decentralized care stations in the medical/surgical environment. This case study explores the impact of the decentralized station across three different patient populations, and highlights additional benefits realized from the design evolution of the decentralized station beyond patient visibility.

Introduction

Beyond patient visibility

In a project completed in 2015, Ballinger architects designed a hospital addition at Penn Medicine Chester County Hospital. Spanning three floors and 72 patient beds, the addition included three medical/surgical patient care units with decentralized caregiver stations between each pair of patient rooms. The design assumption was that staff would spend more time at the patient bedside and patients would receive better care as a result. To validate this hypothesis, a POE investigation monitored, assessed, and compared the clinical staff travel distances and use of the decentralized stations, then correlated the results with the health outcomes of the patients who stayed on the new units. Additionally, the study investigated the impact of the decentralized stations on satisfaction levels of caregivers and patients through survey questionnaires and HCAHPS scores.

The team first used data, information, and responses collected from both patients and staff through Survey Monkey in a multiple choice format with fill-in-the-blank options for clarifying information. Secondly, clinical staff, administrative leadership, and facilities department personnel participated through additional onsite interviews. As a third prong of investigation, the team did onsite observations of each of the four units. Penn Medicine Chester County Hospital provided additional information related to their fall rates, Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) scores, and infection rates on the units both pre and post move for comparison. To limit any internal biases, the research team included additional members of the firm who were uninvolved with the initial planning and construction of the project.

The team investigated the patients and staff on the Ground West unit (constructed in 1962, with a cosmetic renovation in 1998) for a baseline. Ground West was also the location of the same orthopedic patients and staff patients who transferred over to the third floor of the new Lasko Tower building. The Ground West unit was built as a double loaded corridor of rooms with a single nurse station, no decentralized station, and limited support space for staff, compared to the new Lasko Tower units that featured a central work core. By isolating the staff and patient populations, the team could more closely link correlations to the physical changes in the new unit.

The new Lasko Tower units used decentralized stations between every pair of patient rooms, two large stations for collaborative care discussion, and a physician dictation room on the fourth floor for six additional staff members. The second floor post-partum unit required a 16-bed nursery, which displaced some of the clinical staff and created smaller opportunities for nurse stations within the core.

The fourth floor had a total of 30 seats within the central core for a telemetry unit, 24 seats on the third floor for an orthopedic unit, and 12 seats on the second floor for a post-partum unit. The reduction in seats available on the successive units likely encourages caregivers to use the decentralized stations more. The interviews with staff also suggested that on the fourth floor, which has three locations for staff within the core, there were increased problems with locating physicians, who could be at either of the two stations or in the small dictation room.

By posing the same questions for patients in Ground West and Lasko floor three, the investigators were able to identify differences based solely on the infrastructure and facilities changes, as the patient population and nursing staff were consistent before and after the move. The subtle differences in the nursing layouts over the floors and similar finishes on floors three and four of the Lasko Tower allow for comparison between standard units and varied patient needs. Lasko second floor and its contrasting layout of caregiver station within the core, as well as the shift to only 12 centralized seats, creates another level of detail for comparison while maintaining a control for finishes and aesthetics.

FIGURE 1

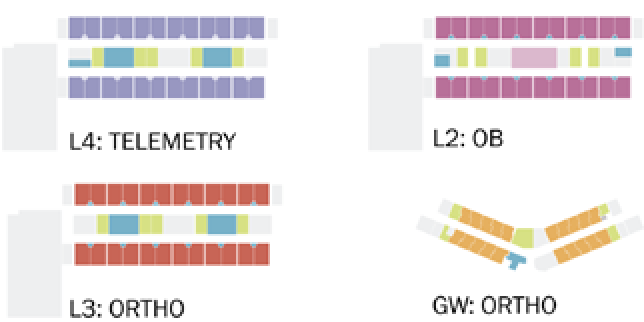
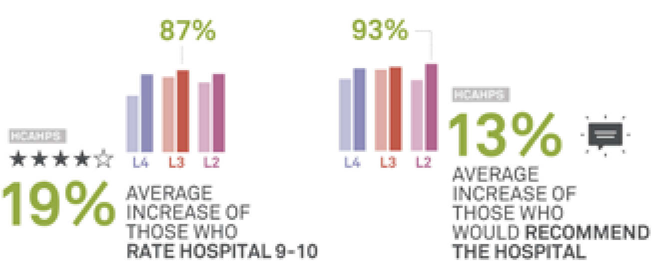


Image credit: Ballinger

FIGURE 2



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Findings

Across all units, the hospital had a dramatic increase in their HCAHPS scores for groups before the move to after the move into Lasko Tower, with average increases of 13–18% over their pre-move units. All of the units in the existing conditions were similar to the Ground West in that they were built as a double loaded corridor of rooms with a single nurse station, no decentralized station, and limited support space for staff. Though it is difficult to contribute all of the increase to the inclusion of the decentralized station, it should be noted that through the survey and interview process, both patients and staff consistently included mention of the decentralized station in their remarks related to satisfaction, perception of care, and work-flow improvements.

Insightful findings were collected related to staff impressions of the decentralized station on their ability to deliver patient care, as well as data indicating that 91% of patients felt that the decentralized stations improved the way in which they were cared for within the unit. This statistic corroborated previous anecdotal evidence of patients requesting their doors be kept opened, or wanting to feel as if someone could help them if they needed assistance. With the decentralized stations, the staff expressed improvements in their ability to check on patients at night without needing to enter the room and disrupt patients' sleep.

Each of the three floors studied in Lasko Tower had subtle differences in their total locations for charting and their use of the decentralized stations. Yet despite Lasko's second floor unit having 18 fewer locations where they could sit and access the EMR, the staff reported consistent and exceptional levels of satisfaction related to accessing the electronic chart.

Staff reported 97%, 94%, and 100% levels of satisfaction across the units for Lasko floors four, three, and two respectively. Lasko floor two, with the least number of seats within the central core for staff, had the highest level of staff satisfaction related to charting locations. This suggests that the needs of the staff were met by the decentralized stations with computer access, the charting station within each of the rooms, and the smaller centralized stations for collaborative group work.

The staff of Lasko floor three had six fewer seats than Lasko floor four staff, which resulted in an additional reported increase of 31% more time spent at the decentralized station. Lasko second floor staff had18 fewer seats on their unit and reported an additional 71% increase in time spent at the decentralized station and a 16% increase in time spent at the patient bedside over Lasko floor four.

FIGURES 3 AND 4

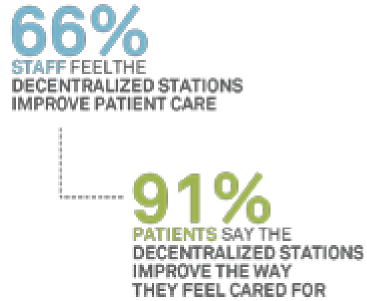


Image credit: Ballinger

FIGURE 5

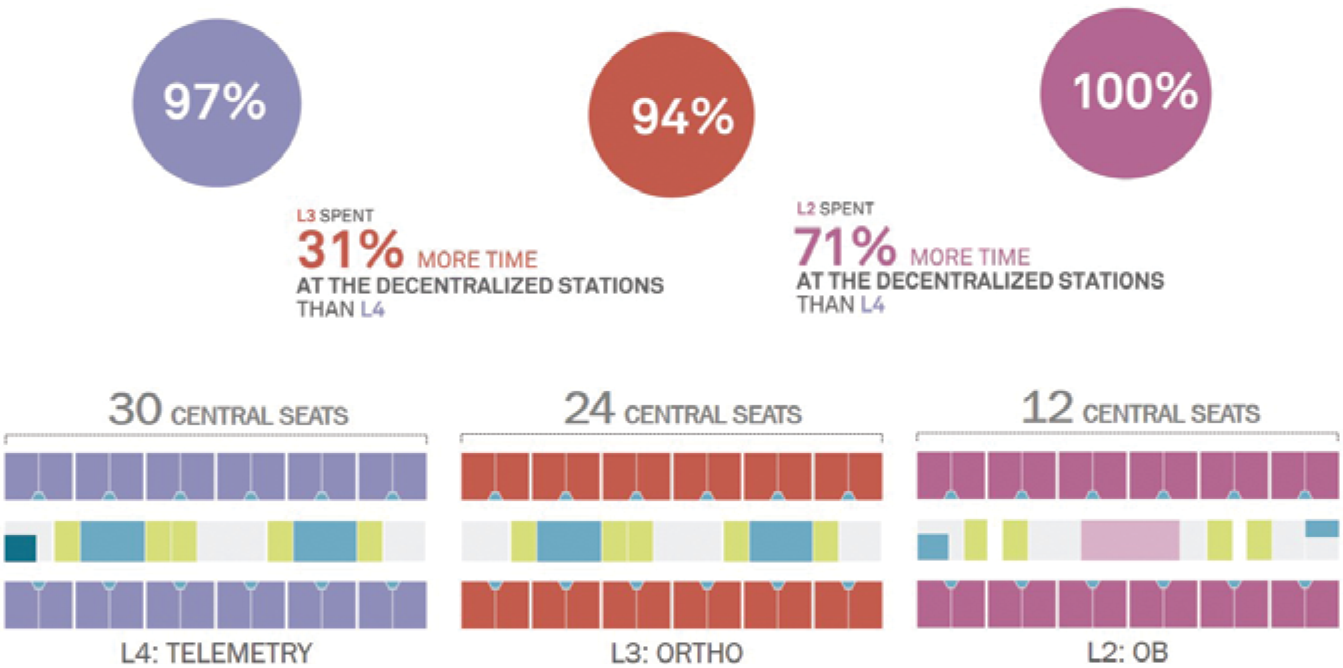


Image credit: Ballinger

Discussion regarding the value of the decentralized station often focuses on the critical nature of the patients and the care level required to adequately care for them. The trend to building critical care units with a direct visualization is now a mandate in the 2014 FGI Guidelines. Little discussion has focused on the value of this design intervention for the less acute patients, and as such, many institutions only build the decentralized model for the acute care environment.

However, with 91% of patients reporting increased satisfaction in the care they receive with decentralized stations and staff reporting a 16% rise in time spent providing patient care, the decentralized station proves to be a valuable addition regardless of the patients' care level. The additional increase in the HCAPHS scores shows that patients in these units appreciate the care being delivered, which translates to financial incentives for the institutions.

After noticing the 16% rise in time spent providing patient care, the team investigated possible drivers in how this additional time could be found during the busy shift of the caregivers. By looking at the floor plans of the three floors, the investigators created a Proximity Index. The Proximity Index used the Y axis to list the 24 patient rooms on the floor, and the X axis to denote various other rooms on the floor such as the clean supply or storage rooms. By then measuring the distances and setting a color gradient to the distances, the team could visually assess the distance discrepancies between the patient rooms and the typical support rooms on the floor. As part of the POE, the team evaluated the fetching distances of staff who were presumably starting their trip from the central station compared to that of staff with a similar roundtrip beginning from a decentralized station. The team then compared each of the sets across the three floors of new construction.

Lasko floors three and four had similar locations for the soiled, clean, meds, and equipment storage. When evaluated with the Proximity Index, they showed as equal. Each trip was considered in feet traveled initially from the central station to a patient room, and then to fetch an item from each of the locations (soiled, clean, meds or equipment storage) before returning to the patient room. This roundtrip for the nursing staff was then applied to each of the typical unit locations. However, instead of starting and ending the trip at the main nurse station, the distances were recalculated using the decentralized station as the origination point and the end point of the trip.

The team reviewed the scores individually, before averaging and comparing their results. In the Proximity Index, the results were color coded with the cooler blue tones denoting trips under the ideal of 140 feet, with those reaching longer distances in the more yellow tones up to a maximum of 270 feet.

For Lasko floor four, a model with the soiled, clean, meds, or equipment storage ran typically from one corridor to the other corridor through the core, with access employed from both corridors into the rooms. In this model, a single soiled room and single equipment rooms showed the longest travel distances for both trips from the central station or from the decentralized stations. Both the clean holding room and the meds rooms were duplicated on the units and showed consistently shorter travel distances.

For Lasko floor two, a model with a cross-corridor through the core and the rooms opening off this corridor was used in a blended model where these frequently accessed rooms were decentralized. Two soiled rooms and two meds rooms were both off the cross corridor. Two additional clean supply rooms used the coast to coast model, and a single storage room was located near the far end of the unit.

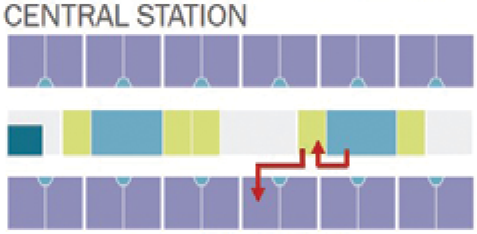
For post-partum patients, the largest needs expressed by the clinicians were centered on the meds, soiled, and clean supply rooms, with little use of equipment. This drove the shift in the core design and contributed to the request of an additional soiled utility room. Lasko floor two shows significantly longer travel distances to the storage room, and this was discussed as a trade-off for this floor. In exchange, the travel distances to the soiled rooms is much shorter than those on Lasko floor four.

After investigating each of the travel distances compared to the adjustments in the core layout between the two units, the team began to look at the overall differences between the central station and the decentralized station usage. Surprisingly, there was a 26% reduction overall in travel

FIGURE 6

ROOM	Clean Supply	Soiled Utility	Meds	Equipment
401	99.25	199.27	179.12	259.92
402	67.42	169.42	147.75	228.08
403	71.67	114.17	92.50	173.50
404	104.50	103.00	81.83	162.17
405	168.08	81.25	116.75	140.75
406	198.08	98.42	146.92	129.42
407	168.08	261.92	116.75	202.92
408	68.50	134.50	148.50	74.33
409	68.67	163.00	93.83	104.00
410	92.25	186.92	73.08	127.58
411	141.92	235.75	90.58	176.75
412	173.17	267.67	122.33	208.67
413	173.08	267.25	144.58	196.25
414	140.58	234.58	112.08	163.42
415	93.25	187.08	95.42	116.92
416	71.33	165.00	116.00	94.83
417	69.25	135.08	171.42	64.08
418	101.25	124.08	203.25	79.75
419	173.25	74.58	143.92	116.08
420	141.17	56.33	111.00	126.00
421	93.67	93.33	95.83	163.00
422	71.00	114.67	116.50	184.67
423	84.25	175.58	171.75	239.58
424	98.00	200.50	201.67	270.00

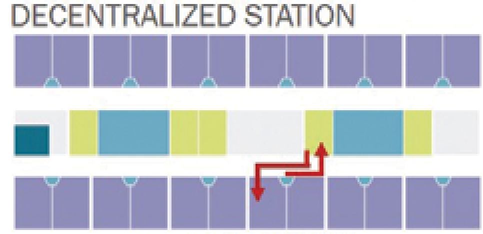
CENTRAL STATION



L4: TELEMETRY

ROOM	Clean Supply	Soiled Utility	Meds	Equipment
401	53.17	153.18	133.03	213.83
402	31.83	133.83	112.17	192.50
403	47.83	90.33	68.67	149.67
404	69.83	68.33	47.17	127.50
405	112.50	25.67	61.17	85.17
406	132.50	32.83	81.33	63.83
407	112.50	206.33	61.17	147.33
408	32.83	98.83	112.83	38.67
409	46.00	140.33	71.17	81.33
410	68.00	162.67	48.83	103.33
411	112.50	206.33	61.17	147.33
412	132.83	227.33	82.00	168.33
413	133.50	227.67	106.00	156.67
414	112.00	206.00	83.50	134.83
415	69.33	163.17	71.50	93.00
416	48.17	141.83	92.83	71.67
417	33.50	99.33	135.67	28.33
418	54.67	77.50	156.67	33.17
419	133.00	34.33	103.67	75.83
420	112.00	27.17	81.83	96.83
421	69.83	69.50	72.00	139.17
422	47.50	91.17	93.00	161.17
423	47.50	138.83	135.00	202.83
424	52.83	155.33	156.50	224.83

DECENTRALIZED STATION



L4: TELEMETRY

Image credit: Ballinger

for the staff if they were typically using the decentralized station instead of the central station on Lasko floors four and three. The same results were compared on Lasko floor two, which had a slightly different arrangement of the support space off a cross corridor. This layout provided a 41% reduction in staff travel distances overall.

It was unclear if the staff themselves noted that they spent less time walking when posted at the decentralized stations, or if the reduction in seats was the primary driver for additional caregivers on Lasko floor two using the decentralized stations more frequently. Regardless of what drove the clinicians to increase their use of the decentralized stations, both outcomes were dramatic and perceived by patients. This is especially considering that the staff on Lasko floor two reported sitting at the decentralized stations 71% more often than their Lasko floor four counterparts. Also noteworthy, when the staff were asked about their level of satisfaction related to the travel distances between staff work areas and patient care areas, the Lasko floor two staff were 22% more satisfied than their Lasko floor four counterparts. The correlation between a 41% reduction in travel distances if using the decentralized station, and a 71% greater use of decentralized station appears to be in direct relationship to increase in satisfaction from the staff.

Conclusion and implications

The POE of these units consistently supports the value of the decentralized stations within the medical/surgical inpatient environment. Patients are able to recognize the differences in care from the staff, and show this with a double-digit increase in HCAHPS scores. Staff reported spending extra time with their patients, increased levels of satisfaction, and up to a 71% reduction in walking distances and travel times when they spent more time at the decentralized stations.

All of these findings from the POE combine for a strong case for the decentralized station in all patient care environments, not just in the critical care units. For a relatively small additional first-time cost, these stations have shown that they provide improved patient care environments. The question should no longer be whether the decentralized station should be included in the medical/surgical environment, but how it might influence care delivery in other departments.

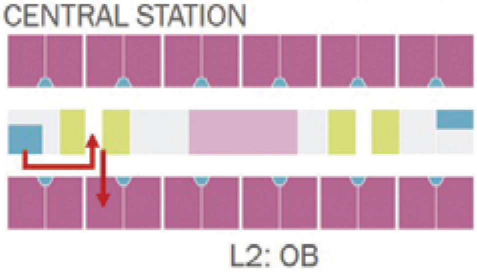
Reference

Hendrich, A.L., Fay J., and Sorrells A.K. (2004). Effects of acuity adaptable rooms on flow of patients and delivery of care. *American Journal of Critical Care*, 13 (1) 35–45.

FIGURE 7

ROOM	Clean Supply	Soiled Utility	Meds	Equipment
201	64.92	118.25	96.08	334.08
202	51.58	106.08	82.42	321.42
203	89.33	110.17	89.00	299.83
204	121.42	142.08	120.75	289.42
205	186.42	205.25	185.75	267.58
206	257.50	238.50	217.17	256.33
207	190.92	246.92	227.25	244.08
208	157.92	214.75	194.75	211.42
209	103.92	151.08	130.92	147.75
210	114.67	130.67	110.83	115.17
211	135.17	152.17	132.33	81.00
212	146.58	163.08	143.25	92.42
213	139.92	136.25	156.25	85.92
214	69.08	125.58	145.58	74.25
215	108.42	104.42	124.92	111.25
216	96.92	124.25	144.75	142.75
217	150.75	187.75	207.75	205.58
218	184.67	221.17	241.33	239.00
219	272.25	270.58	292.25	270.75
220	237.92	237.42	259.25	322.25
221	175.25	174.58	195.42	343.42
222	142.75	141.92	164.08	353.42
223	107.00	137.33	158.67	375.50
224	117.25	147.42	169.58	386.42

CENTRAL STATION



ROOM	Clean Supply	Soiled Utility	Meds	Equipment
201	55.33	108.67	86.50	324.50
202	33.50	88.00	64.33	303.33
203	49.50	70.33	49.17	260.00
204	70.83	91.50	70.17	238.83
205	114.33	133.17	113.67	195.50
206	175.00	156.00	134.67	173.83
207	79.33	135.33	115.67	132.50
208	57.33	114.17	94.17	110.83
209	24.50	71.67	51.50	68.33
210	46.33	62.33	42.50	46.83
211	87.33	104.33	84.50	33.17
212	109.33	125.83	106.00	55.17
213	108.67	105.00	125.00	54.67
214	27.33	83.83	103.83	32.50
215	44.67	40.67	61.17	47.50
216	23.00	50.33	70.83	68.83
217	55.67	92.67	112.67	110.50
218	78.33	114.83	135.00	132.67
219	135.33	133.67	155.33	133.83
220	112.00	111.50	133.33	196.33
221	70.67	70.00	90.83	238.83
222	48.50	47.67	69.83	259.17
223	34.33	64.67	86.00	302.83
224	55.50	85.67	107.83	324.67

DECENTRALIZED STATION

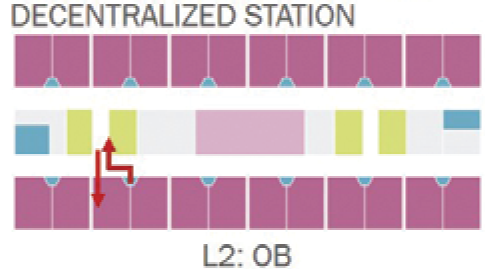


Image credit: Ballinger

An Efficient Method for High-Performing Healthcare Facilities

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ABSTRACT

This paper discusses the unique challenges and pressures with which health facilities must cope when accomplishing repair, alteration, and construction projects. It also explores the applicability of the Job Order Contracting construction procurement method for hospital and healthcare systems.

A 2015 study by Arizona State University's Performance Based Studies Research Group set out to analyze the performance and value of the Job Order Contracting (JOC) process. The study measured the performance, satisfaction, and economic impact of JOC compared to other construction procurement methods, and gained the perspective of facility owners and contractors through survey questions. The paper will discuss the results of this study and how the JOC process can and is being used as an efficient and effective construction procurement process for the streamlined repair, renovation, and alteration of hospitals and healthcare facilities.

The paper will further analyze case study examples at three healthcare systems and discuss how the JOC method has been used to procure construction projects at the Jackson Health System, Harris Health System, and NYC Health + Hospitals. The case studies will discuss overall JOC programs, types of projects procured, and benefits associated with the program.

Introduction

Hospitals and healthcare systems are not immune to the challenges of repair, modernization, and renovation projects. Compressed construction timelines and strained budgets add to the pressure of facility alterations to contend with technology updates, patient demands, green and sustainable upgrades, and security improvements. Hospital and healthcare systems continue to make facility adjustments and advancements to meet the needs of patients and seek construction procurement processes that are efficient, effective, and flexible enough to meet their needs. Hospital repair and alteration projects such as exam room renovations, medical equipment upgrades, facility consolidation, HVAC upgrades, or energy retrofits have been successfully accomplished with the JOC construction procurement method. This indefinite delivery, indefinite quantity process accommodates healthcare facilities' construction demands to quickly procure projects. It has also been proven to save time and costs while providing high satisfaction ratings.

Job Order Contracting was created to tackle the demanding requirements, tight timeframes, and stringent complicated competitive bidding requirements at US Army facilities in Europe. JOC aims to simplify and streamline the process of completing straightforward repair and renovation projects. Over the years, JOC has become a preferred method of facility owners to accomplish a large number of repair and renovation projects with a single, competitively bid contract.

As the saying goes "failing to plan is planning to fail." Healthcare construction is no exception to this reality. Architects, engineers, facility owners, and contractors need to ensure that both the construction plan is solid and that all end users have buy-in. The project's mission needs to be more than just that of the patient, but also that of the nursing staff, doctors, and administrators. By engaging JOC contractors early in the design phase, architects and engineers will be able to gain a unique perspective on the project, helping avoid potential costly mistakes down the road. Often, onsite experience will give contractors knowledge of the ins and outs comparable to that of facility personnel. This represents an opportunity when it comes to developing a project's scope of work. In addition to valuable scope input, JOC contractors can also work side by side with architects and engineers in developing the costs for the project using the pre-priced construction task associated with the JOC contract.

With the popularity of Integrated Project Delivery (IPD) on the rise, those looking to get the most out of their design, construction, and commissioning would be wise to use a JOC contractor in the IPD process. Just as the goal of an IPD process is to foster communication and teamwork among all parties to see the project completed faster, so too is the goal of a JOC contract. However, there is one paramount difference: In traditional IPD processes, construction costs are still developed through a budgeting process and are not truly known until the subs or suppliers are contracted. Also, in case of a change order, these are typically still priced the traditional way. Incorporating JOC into your IPD process eliminates those cost concerns because all the pricing will be derived from the pre-priced task catalog associated with the JOC contract. All construction costs have been defined and assigned well before the planning phase, and costs can be more easily controlled throughout the IPD process. Also, all change orders will be priced from the same task catalog, thus protecting the owner from change order escalation. Using JOC in your IPD process fosters the best collaboration possible while still offering the owner true construction cost protection.

With JOC as the procurement method for a project, everyone is on the same page. What follows throughout the entire construction lifecycle will be true collaboration. Knowing the project has been successfully bid, the contractor can immediately plan to ensure schedules, budgets and personnel requirements are met. Because the contractor's prices are pre-priced, architects and engineers can develop the scope with confidence that costs will not balloon out of control. Architects and engineers now have a direct conduit for identifying constriction prices and potential constriction issues at the very early stages of planning when adjustments can be made quickly. And if cost overruns do arise, the JOC contractor will be present to assist in keeping costs in line and the project development moving forward. Conversations about how best to design, develop and execute the project can now take place amongst architects, engineers, and contractors. Facility managers will have confidence they are using a contractor who already knows their systems and practices. All parties succeed.

In 2015, the Performance Based Studies Research Group (PBSRG) from Arizona State University's Del E. Webb School of Construction set out to analyze the performance and value of the JOC process. The result was the Job Order Contracting Performance Study which measured the performance, satisfaction, and economic impact of this process. The survey was completed by 47 owner companies and 13 contractors who represent $5 billion in construction projects. Survey participants included facility owners from hospital and healthcare systems, housing authorities, institutions of higher education, K-12 systems, cities and counties, transit authorities, and more.

The differences between JOC versus design-bid-build and design-build boil down to a single, crucial detail: pre-priced tasks. Although absent in the two traditional procurement methods, this concept is the foundation of JOC. With pre-priced tasks, costs are determined upfront and cannot be altered. This changes the fundamental relationship between contractor and owner (along with design team). With prices established ahead of time, there's no monetary advantage for the contractor not being totally transparent from the onset. If the contractor notices a design flaw in the plans, there is no lucrative change order that can be executed down the line. This makes the cost for a contractor to bring the flaw to the attention of the designer early on the same as it would be in the middle of construction.

When properly implemented, JOC contracts give substantial cost protection to the owner and design team. Plus, when done correctly, JOC projects cost less than those procured through traditional methods as it is not a "one and done" situation. Often, JOC contracts last four or five years. During that time, the contractor has the ability to spread overhead across many different projects, thus reducing the owner's cost. On the other hand, with design-bid-build and design-build, the contractors is only looking in terms of one project and must make all profits through that single job. There is no other procurement method that delivers this level of construction cost protection to owners, architects, and engineers.

Research has found that only 2.5% of all projects are delivered on time and within the planned cost (PricewaterhouseCoopers, 2009) establishing a great need for faster, better methods of completing repair, modernization, and renovation projects efficiently while staying on deadline and on budget. Inefficiencies costing those in the industry up to $36 billion per year in lost time and fiscal overages (Lepatner, 2007). Researchers at Arizona State University spent 24 years and more than 1800 tests to identify the source of these issues (Rivera, 2014). They found that a primary cause in low construction project performance is the traditional design-bid-build construction procurement method. Other approaches, including design-build and CM at risk were not found to be a solution to the problem of project inefficiencies and low project satisfaction. The 2015 PBSRG study focuses on JOC, with overwhelmingly positive results in project satisfaction, timeliness, cost savings, flexibility, transparency, and ease of use.

Greater satisfaction

The study found that respondents rated 96% of JOC projects as satisfactory, while almost all (99%) owner participants said they would recommend the JOC method to other facility and infrastructure owners. These high satisfaction marks derive from the time and cost saving benefits from JOC, as well as overall transparency, flexibility and efficiency. Owners were 60% more satisfied with the JOC process compared to design-bid-build or design-build.

Time savings

Job Order Contracting streamlines the bidding process by putting contractors in place to perform a number of projects with a single-competitively bid contract, enabling construction work to begin faster. Contractors who compared the process to design-bid-build and design-build found the JOC process outperforms others on delivering projects on time. Contractors responded that 94% of projects procured using Job Order Contracting are delivered on time, compared to only 63% for design-bid-build and 73% for design-build.

Budgetary control & cost savings

Cost savings is a cornerstone of the JOC process, typically resulting from increased efficiencies in four areas: procurement, design, construction and post construction. Owners reported saving, on average, 24% in administrative costs compared to other methods, while contractors reported a 21% total cost savings throughout the project. Regarding the cost savings, owners most commonly mentioned procurement administrative time, project manager support time, design and drawing costs, and decreased documentation demands as main contributing factors to the cost savings. The contractors surveyed felt that acquiring and bidding new projects, a decrease in change orders and decreased time requirements most impacted their cost savings.

Transparency & flexibility

More benefits that are associated with the JOC procurement method are the transparency and flexibility it brings to projects and processes. Owners responded that transparency is on average 30% higher for JOC than traditional construction delivery methods. Owners also believe JOC to be an average of 76% more flexible than other methods.

Case studies

NYC Health + Hospitals operates the public hospitals and clinics in the five boroughs of New York City. With 225,000 admissions, one million ER visits and five million clinic visits by New Yorkers annually, New York City Health + Hospitals sought a streamlined solution to procure straightforward construction, demolition and renovations work at its facilities. In 2010, New York City Health + Hospitals implemented a JOC solution and has completed over $59 million in construction work through the program. New York City Health + Hospitals has used its JOC program for projects including renovation of clinic examination rooms, HVAC upgrades, electrical efficiency projects, mold and asbestos abatement, and more. Through its JOC solution, projects are managed from initiation to close-out and onsite construction management experts carry out the day-to-day operations, allowing New York City Health + Hospitals to focus on other projects.

Harris Health System is a fully integrated healthcare system that cares for residents of Harris County, Texas. This system includes 23 community health centers, five school-based clinics, a dental center, and dialysis center, mobile health units, a rehabilitation and special hospital and two full-service hospitals. Since they implemented a managed JOC process in 2011, almost $16 millions of work has been completed through the program. Projects completed include moisture repairs, roof replacements,

FIGURES 1–3

(Left) Before Photo; (Center + Right) Hospital call center after photos
Image credits: Gordian

dental clinic renovations, security upgrades to entrances, X-ray equipment upgrades, treatment room renovations, and more. With JOC, Harris Health System found projects were completed more quickly. The customized task catalog of construction line items includes costs local to Harris Health System, along with their special standards and specifications.

Jackson Health System is a nonprofit academic health system in Miami-Dade County. The health system includes six hospitals and a growing network of primary care clinics, specialty care programs, urgent care centers, behavioral health facilities, skilled nursing facilities, and a corrections health service. They have completed more than $55 million in construction work through a JOC procurement program since its implementation in 2008. Projects completed through the program include cardiac cath lab expansions, trauma center renovations, roof replacements, oncology infusion lab renovations, and more. Implementation of JOC for Jackson Health System's repair, renovation, and minor construction needs allows them to complete more projects through process efficiency and provides transparency and auditability throughout each stage of the process.

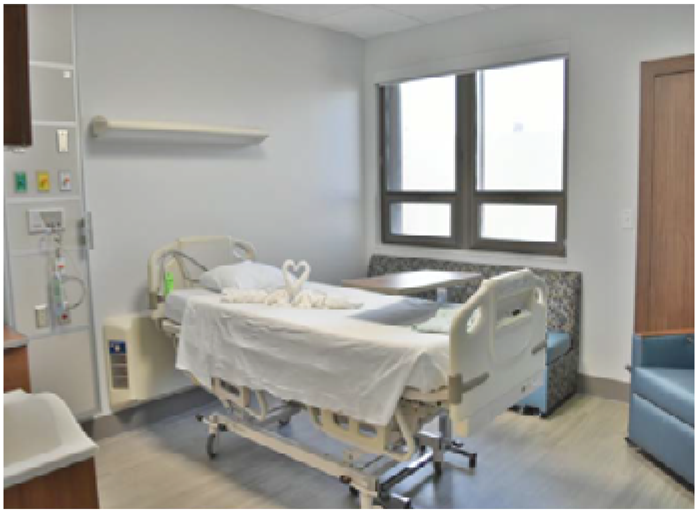
An efficient process

The JOC construction procurement method is an ideal solution for hospital and healthcare facilities that seek a faster way to update and renovate their facilities and infrastructure. Research has shown the JOC process saves time, saves on costs, and provides high satisfaction ratings for those who use it compared to other procurement methods. As hospitals and health centers continue to make improvements and modernizations, the JOC process can help keep them on deadline and on budget.

FIGURE 4

Renovated Vascular Angio Recovery Unit
Image credit: Gordian

FIGURES 5 AND 6



(Left) Patient suite pre-renovation and (right) patient suite post-renovation
Image credits: Gordian

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Big Growth Needs Big Data

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ABSTRACT

As hospitals continually grow to meet the demands of advances in medicine and technology, there is a desire for facilities to become leaner, more flexible, and efficient, without compromising the quality of care. Trends toward private inpatient rooms, patient- and family-centered care models, and the adaptation of acuity adaptable or universal rooms have resulted in patient rooms that are 77% larger than they were in 1980 (Schneider, 2009). Subsequently, inpatient units have also grown, shifting the models of care and causing increases in staff travel distances and decreases in patient-direct visibility (Harper et al., 2014). As the demand for space increases, owners are seeking design opportunities to optimize space and save costs.

Benchmarking, when integrated into the design process, provides the means to confidently design right-sized facilities by utilizing key metrics to baseline and optimal targets for performance and outcomes (McCabe, 2001). Several benchmarking programs developed by architecture firms and industry-wide organizations, such as the Construction Industry Institute (CII), capture these metrics as a means for evaluation, assessing how a facility's design and construction performs against other industry leaders across the United States. In conjunction with the CII Health Care Benchmarking Program, a study of 32 medical/surgical inpatient units and 60 inpatient rooms was conducted to identify areas of achievement, improvement, and opportunities to optimize space and operational efficiency throughout the design phases of a project.

Introduction

Today's hospitals struggle to find a balance between providing the highest quality of care, patient and staff satisfaction, operational efficiency, and spatial efficiency. The continuous evolution of patient-care models and advances in medicine have directly impacted building standards and recommendations for inpatient room and unit design, often increasing facility size. As facilities grow, clinicians are continually faced with challenges in providing optimal care, maintaining effective communication, and promoting efficient operations, while adapting to larger care environments.

Examination of previously constructed facilities can provide accurate data and inform the design of future projects. Benchmarking, the systematic process of measuring one's performance against recognized leaders to determine best practices, is a continuous exercise that can be applied to identify the appropriate size for facilities (National Research Council, 2005).

In its simplest form, benchmarking helps organizations identify areas of achievement and improvement to define a better, more successful outcome (McCabe, 2001). The value of an assessment is recognized in the numerous metrics that can be used to measure the performance of a healthcare facility. Metrics evaluating space planning, program space requirements, and operations are used to accurately determine the appropriate size of a patient room, department, or facility. It is important to understand that there is no "one size fits all" solution; it is necessary to go beyond the numbers and understand what conditions and variables were responsible for generating them. Understanding these conditions and analyzing multiple metrics will help deliver insights for both planning performance gaps and best practices.

Trends in health care that impact growth

Inpatient units have evolved from the open room 1860s Nightingale Wards to today's single-occupancy room model, impacted by trends in patient-family centered care, acuity adaptability, in-room clinical services, and patient size. This shift in patient care has led to improved clinical outcomes while also resulting in a significant increase in room size and a further increase in inpatient unit size.

Now in its seventh edition, the *FGI Guidelines* has provided performance-driven standards for American health facility design since 1947. These guidelines have continued to evolve and are maintained and updated by a multidisciplinary group of experts to reflect advances in medicine and patient care (Facility Guidelines Institute, 2017). Today, some version of the *FGI Guidelines* has been adopted by 36 states (American Society for Healthcare Engineering, 2015).

The number of patients permitted in a medical/surgical inpatient room has evolved as studies have demonstrated the benefits of a single-occupancy room, including reductions in length of stay, medication errors, patient transfers, infection rates, noise levels, and sleep disturbances, and increases in patient satisfaction and privacy (Chadbury et al., 2004). In 1987, the maximum

FIGURE 1

ROOM LISTING	1987 NEW CONSTRUCTION- MINIMUM CLEAR FLOOR AREA	2001 NEW CONSTRUCTION- MINIMUM CLEAR FLOOR AREA	2006 NEW CONSTRUCTION- MINIMUM CLEAR FLOOR AREA	2010 NEW CONSTRUCTION- MINIMUM CLEAR FLOOR AREA	2014 NEW CONSTRUCTION- MINIMUM CLEAR FLOOR AREA
ACUTE CARE					
PRIVATE ROOM	100	100	120	120	120
MULTIPLE BEDS	80	120	100	100	100
INTERMEDIATE CARE					
PRIVATE ROOM	n/a	n/a	150	150	150
MULTIPLE BEDS	n/a	n/a	120	120	120
INTENSIVE / CRITICAL CARE					
PRIVATE ROOM	120	200	200	200	200
MULTIPLE BEDS	100	200	200	200	200

***CLEAR FLOOR AREA:** THE FLOOR AREA OF A DEFINED SPACE THAT IS AVAILABLE FOR FUNCTIONAL USE EXCLUSIVE OF TOILET ROOMS, CLOSETS, LOCKERS, WARDROBES, ALCOVES, VESTIBULES, ANTEROOMS, GENERAL CIRCULATION,AND AUXILLARY WORK AREAS. FLOOR SPACE BELOW SINKS, COUNTERS, CABINETS, MODULAR UNITS, OR OTHER WALL-HUNG EQUIPMENT THAT IS MOUNTED TO PROVIDE USABLE FLOOR SPACE COUNTS TOWARD "CLEAR FLOOR AREA."

FGI patient room size requirements for new construction: 1987-2014
Image credit: HKS; Source: *FGI Guidelines*

number of patients in a room was four, decreasing to two in the 2001 edition, and one patient per room in the 2006 edition. The minimum clear area of a patient room in a medical/surgical nursing unit identified by the FGI Guidelines increased in 2006, from 100 sq ft to 120 sq ft (Facilities Guidelines Institute, 2014). While the minimum clear area remains the same, recommendations in the Appendix of the Guidelines states that "in new construction, single patient rooms should be at least 12 feet wide by 13 feet deep (or approximately 160 sq ft)" (Facilities Guidelines Institute, 2001). This reflects the need for larger rooms to accommodate changing care models, increased space for equipment, and dedicated space for family members to be present in the patient room without impeding care. A key piece of equipment—the patient bed— has increased in size, growing from seven feet long to upwards of nine feet in recent years, with an added increase for bariatric patient beds, which may be over four feet wide. This increase not only requires more space in the patient room, but also requires additional clearances in corridors for maneuvering, increasing circulation space in inpatient units.

The patient- and family-centered care (PFCC) approach focuses on creating partnerships among healthcare practitioners, patients, and families that lead to the best outcomes and enhance the quality and safety of healthcare (American Hospital Association, 2004). This model has been shown to decrease readmission rates and length of stay while increasing staff and patient satisfaction scores (Planetree, 2014). The FGI Guidelines recommend a clear area of 250 sq ft in hospitals with a PFCC model, with a 15' clear dimension. The ripple effect of this recommendation includes longer corridors, increased unit size, and added clinical support areas to support staff efficiency.

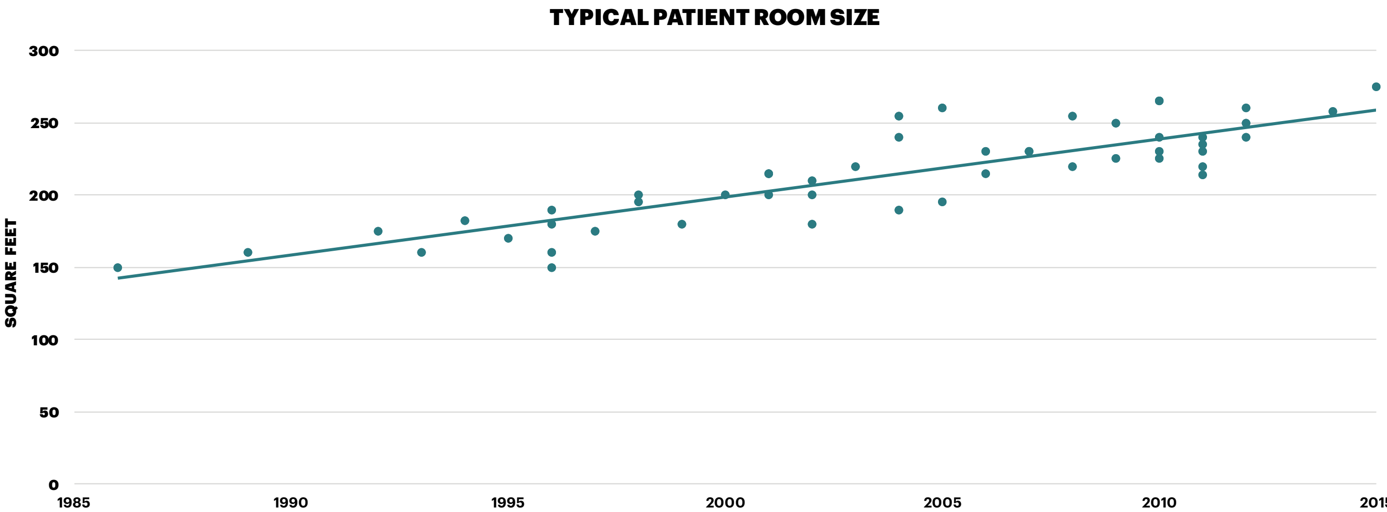
The introduction of acuity-adaptable rooms to reduce patient transfers and medical errors, while increasing patient satisfaction, is another inpatient-care trend with space implications. Acuity-adaptable rooms are inpatient rooms that can be configured to meet the needs of intensive care, stepdown, observation, and acute-care patients, enabling a patient to stay in the same room from admission through discharge (Annonio et al., 2010). For this model to be successful, each patient room must accommodate requirements for an intensive care room, increasing size and equipment needs beyond the requirements for acute-care patients. To further meet the goal of limiting patient transfers, inpatient rooms are being designed to accommodate in-room clinical procedures, including certain imaging procedures, dialysis, and physical/occupational therapy.

As a result of these trends in patient care, the inpatient unit has also increased in size. Larger patient rooms mean longer inpatient unit corridors, increased need for decentralized staff workstations and charting alcoves to maintain patient visibility, decentralized supplies, and improved technology for communication.

Understanding the implications

As health outcomes, patient experience, and operational efficiency become key drivers in the healthcare industry, it is important to understand the implications these trends have on spatial performance and, ultimately, construction

FIGURE 2



Patient room size growth: 1986-2019
Image credit: HKS

costs. The desire to include these additional functions and dedicated areas within the patient room has caused the patient room to grow by more than 77% since 1980 (Schneider, 2009). While these trends have known benefits that include improved patient satisfaction and decreased medical errors, the accommodation of these patient-experience improvements has increased the size of inpatient units and has required further shifts in the care model and the organization of the unit (Cullinan and Wolf, 2010).

An analysis of 32 units, dating between 1986 and 2014, including sixteen 36-bed, nine 30-bed, and seven 24-bed units, affirms the notion of the growing patient room and inpatient unit over time. A simple break down of the inpatient unit separates the program into four categories for analysis.

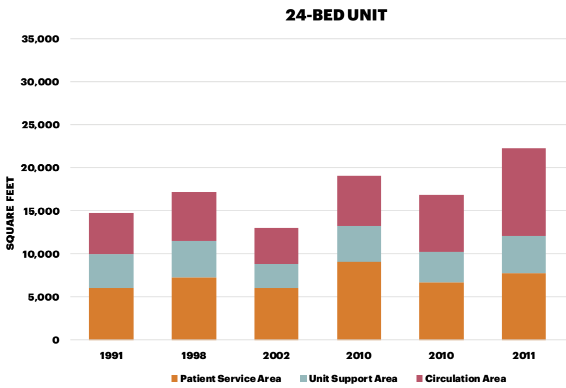
- patient service area: The net square feet of patient rooms, patient room toilets, and nurse servers
- support service area: The net square feet of clinical support areas such as medication rooms, clean supply, nurse stations, charting areas, and team rooms
- circulation area: The remaining square feet of the unit, including corridors, staff passageways, and lobbies
- building support area (not included in the inpatient unit area calculations): Vertical circulation, elevator lobbies, stairs, mechanical rooms, and significant wall shafts

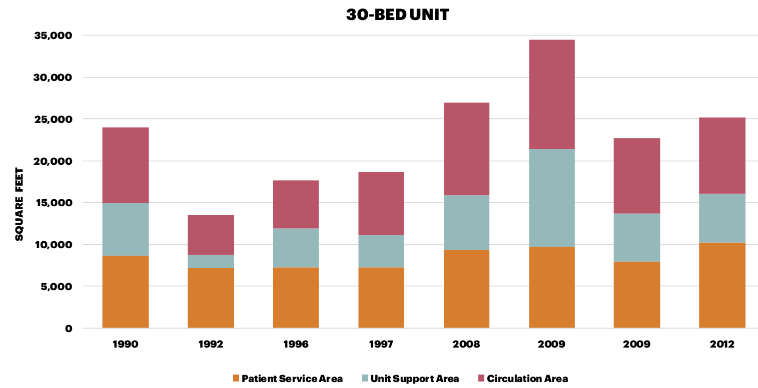
Additionally, travel distances for a nursing shift are calculated using a parametric script in Grasshopper, software that analyzes the plan of the inpatient unit. This script measures the distance—using the centerline of hallways, 90-degree turns, and the center of doorways as a start and finish point—between key rooms in a series of sequences that a nurse will follow in a shift. These sequences and their frequency are modeled after current nursing models and case studies and the output reflects the average distance of all possible configurations of the chosen patient rooms to ensure validity and consistency. Once the distance is calculated, time is calculated with an equation—total miles x 15 min/mi—that suggests a moderate speed walk.

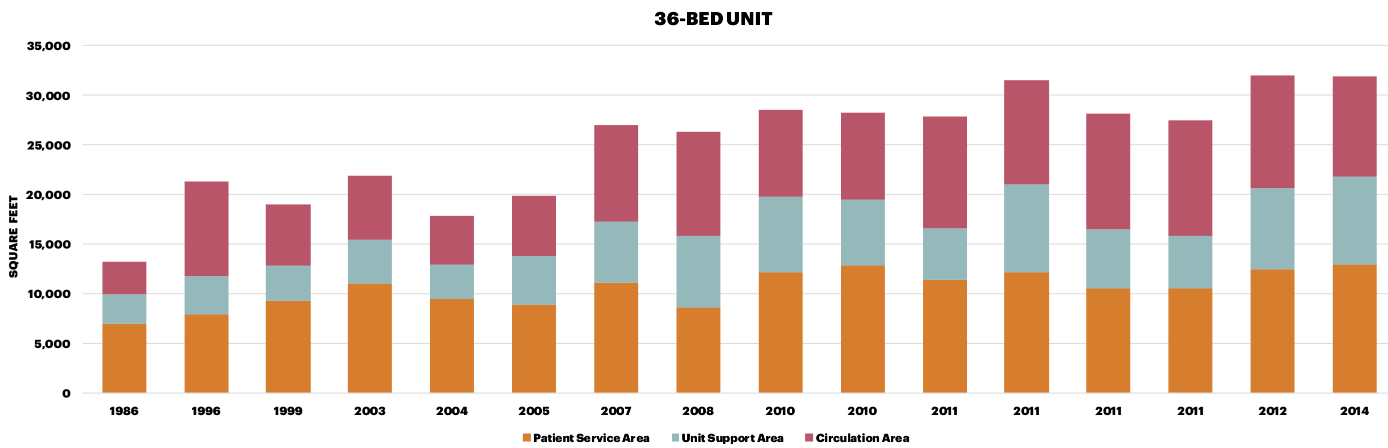
A comparison of a 36-bed inpatient unit constructed in 1986 to a unit of the same bed count constructed in 2014 shows a growth in the patient room of 100 sq ft (exclusive of the toilet room), a 63% increase. As shown in figure 5, the 36-bed unit as a whole had a total increase of 140%, growing at a rate of 3% each year. Despite this increase in overall unit area, the distance a nurse might travel within a typical shift decreased eight minutes, or a half-mile, each day. This recovered time provides more face time with the patient and decreases physical strain on the staff. The 2014 unit facilitates a shorter travel distance, despite being twice the size of the 1986 unit because of the unit's decentralized model.

As the inpatient unit grew, the support services of the unit needed to respond; although simply enlarging the areas of support services would not be sufficient since the units are occupied by the same number of patients. The

FIGURES 3–5

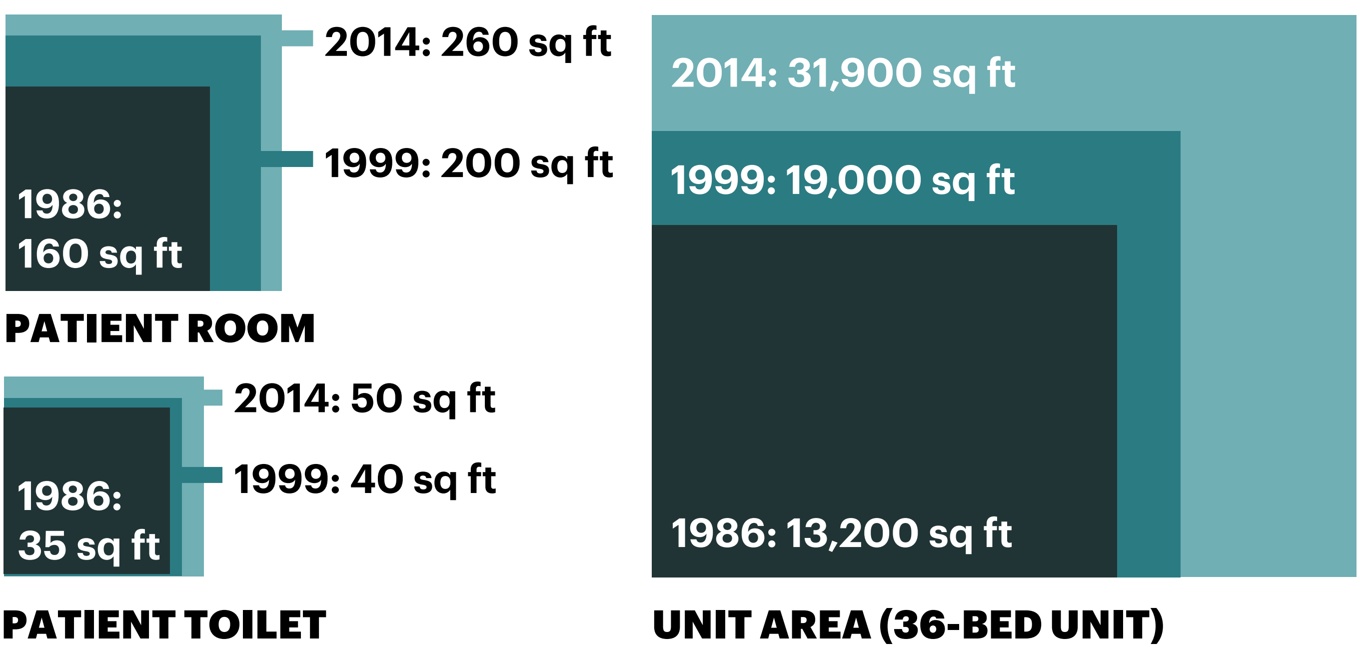






Inpatient unit area growth for 24- ,30-, and 36-bed units: 1986–2014
Image credit: HKS

FIGURE 6



Growing medical/surgical patient unit and room: 1986–2014
Image credit: HKS

introduction of a decentralized unit and planning with an emphasis of access between support spaces and the patient rooms streamlined throughput of tasks throughout a shift, reduced the time spent gathering supplies, and allowed more time with the patient. To shorten travel distances for care givers, nurse servers and charting stations are added to the corridors, allowing nurses to gather supplies and chart adjacent to the patient room. Additional supply and equipment rooms with multiple points of access can also reduce travel distances while adding additional area to the unit.

The addition of these spaces and access points can add additional area through redundancies to the unit. Across the selection of 36-bed inpatient units, units with decentralized medication rooms saw a 3% increase in unit support area and a unit-area growth of 45 sq ft/bed above the average unit area sq ft/bed for the selection.

Overall, a breakdown of unit growth from 1986 to 2014 by program in the sample of 36-bed units reveals that the growth rate of the support area and circulation areas, 192% and 211%, respectively, far surpassed the 87% patient-service-area growth rate from 1986 to 2014. Both the unit support area and the circulation of the units grew at a rate of 4% each year.

The tradeoffs between operational efficiency and spatial efficiency are difficult to weigh. Operational efficiency effects patient and staff satisfaction, can reduce medical errors, and can increase collaboration amongst the care team, whereas spatial efficiency directly impacts construction and operational costs. A balance between the two must be achieved to create a cost-effective, high-performing facility. To find this balance, architects and owners can analyze historical data of facilities implementing different strategies and models to determine the best practices for new facilities through the use of a benchmarking practice.

Strategies for benchmarking practices

A benchmarking practice can be established to evaluate and maintain the balance between cost-effective and high performing. A benchmarking practice may be established as either an internal firm evaluation or an external industry evaluation.

An internal benchmarking practice refers to collecting information on projects within a firm's portfolio and comparing them to establish general guidelines and reveal best practices. An example of an internal practice is one focused on a study of the acute care and intensive care inpatient units, isolating the space planning and program organization of the firm's designs for a critical component of a hospital.

An external benchmarking practice compares a firm's projects to projects designed by industry competitors to determine where the firm stands within the industry. This requires additional collaboration but also brings a larger reward with the cooperation and sharing of information with industry competitors.

Without industry data, there is no way to truly define "good performance," only good performance within one's firm (National Research Council, 2005). A best practice has more weight when it is defined by the industry as a whole rather than what work the firm performs alone and measured with meaningful metrics.

The Construction Industry Institute (CII) at the University of Texas at Austin has created a Health Care Benchmarking Program, available at no cost to participants, which eliminates the burden of developing a benchmarking practice for the firm. In exchange for contributing project data, this program provides access to an impartial industry database of metrics and comprehensive data on healthcare facilities across the country. The CII Health Care Benchmarking Program allows participating firms to compare their projects to others in the industry throughout all stages of design. In early phases of master planning through post occupancy evaluation, the CII Program can provide an overview of the areas of achievement and opportunities for improvement in terms of a facility's construction cost, schedule, design, and space planning.

Performance analysis of an inpatient unit

A benchmarking analysis of an acute care unit in an academic medical center compares a recently completed inpatient bed tower to five similar academic bed towers, utilizing an internal database of inpatient care units and the CII Health Care Benchmarking Program. The database of inpatient care units was utilized to analyze four key metrics, revealing the space usage and performance of the selected unit against the 50+ project database.

- Unit area/bed: The area of the inpatient unit in comparison to the number of beds it contains exposes the efficiency of the unit's footprint. The more beds that are located on an inpatient unit, the more efficient the unit.
- Percent of support area/unit area: The ratio of support service area to the inpatient unit reveals the utilization of the unit.
- Net-to-gross factor: The net-to-gross factor compares the inpatient gross area to the patient services area and the unit support area.
- Typical patient room size (exclusive of toilet rooms): A larger patient room can provide adequate space for patient care and family space. An oversized room, however, can promote inefficiency.

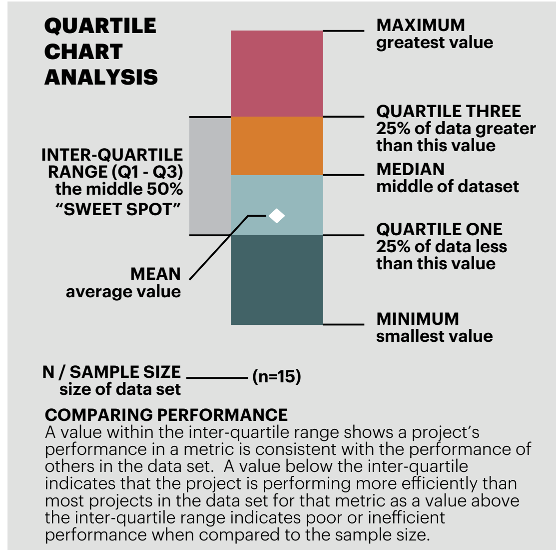
The unit-area-to-bed ratio reveals a large footprint and a high net-to-gross factor, inefficiency that can be attributed to the academic nature of the facility, requiring additional circulation to accommodate a separation of front-of-house and back-of-house functions, as well as spaces required for education throughout the facility. The patient rooms lie within the interquartile range, slightly larger than the average patient room sizes, indicating that the rooms are appropriately sized when compared to similar facilities and further indicating inefficiencies in circulation spaces.

The metrics provided by the CII Health Care Benchmarking Program were utilized to compare the performance of the selected projects, assessing the space program of the entire facility and costs to design and construct the facility.

- DGSF/BGSF: The facility is comprised of 58% department gross square feet (DGSF). This indicates that a significant portion of the building, 42%, is reserved for building support and service spaces.
- Construction cost/BGSF: The total building construction cost of the facility was less than the facilities in the CII database at $400/BGSF.
- Project cost growth: The project cost grew significantly from the initial schematic design estimate. The 25% increase is well above the average 6.6% increase; however, it is still lower than a majority of projects in the database. This increase can be attributed to the addition of multiple schematic design phases to incorporate additional programs in the new facility.

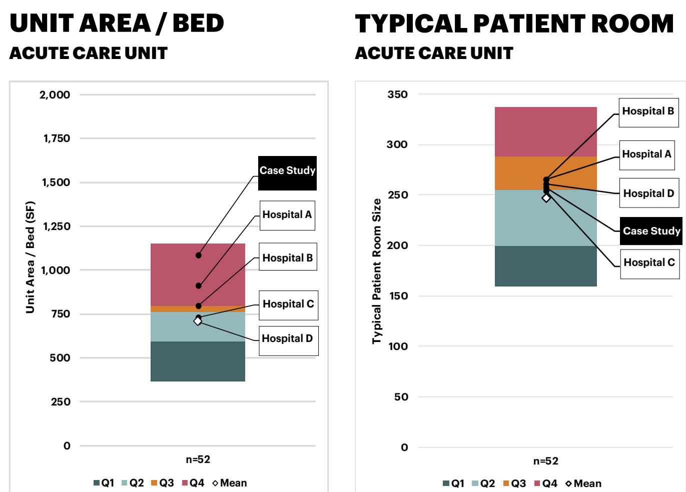
The metrics provide a holistic evaluation of a recently completed facility against several comparable facilities, highlighting both its strengths and weaknesses and serving as a road map for how to move forward with future facility design and planning. This benchmarking exercise provides the necessary framework to use past experiences of both the client and the firm to pursue a new project together, aware of common goals, areas of achievement and, most importantly, areas of improvement.

FIGURE 7



Interpreting a quartile chart
Image credit: HKS

FIGURE 8



Q1 - Q3	593 - 794
Mean	707

Q1 - Q3	200 - 288
Mean	247

Inpatient care unit study metrics
Image credit: HKS

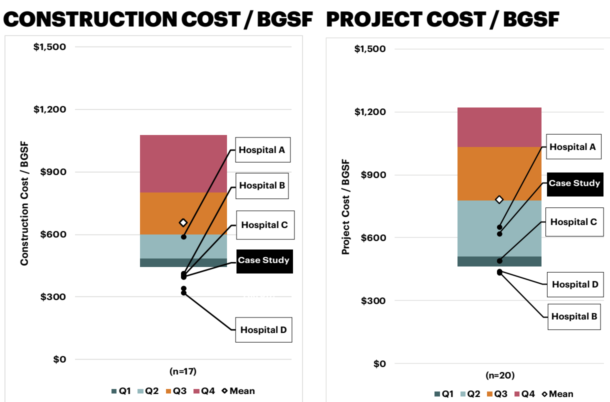
Roadmap to right sizing facilities

Before the planning and design process begins, a benchmarking assessment can compare an existing client project or selection of facilities with the desired product. This allows the client to understand and set expectations for construction performance, size requirements, and operational performance of the facility. Performing a benchmarking assessment early and throughout the process allows the team to establish targets and track them throughout the project. As the project proceeds, the project can be assessed in terms of size, cost, and project schedule, assisting clients with making key decisions throughout the project, tailored specifically to the project goals. These metrics establish a norm for the different variables that exist when designing a facility.

During the design development phase, an assessment can be made to measure the status of the project and assess its performance against key metrics to identify anomalies or changes made to the initial targets that require further review. Not all deviations from original targets or comparable projects are an indication of where adjustments are needed to provide an optimal, high performing facility; some diversions from the program may be warranted and appropriate.

After the project is constructed, it is important to assess the final product to identify areas where the project succeeded, as well as areas that could be improved in future projects. The data collected in this stage is then archived for use on future projects.

FIGURE 9

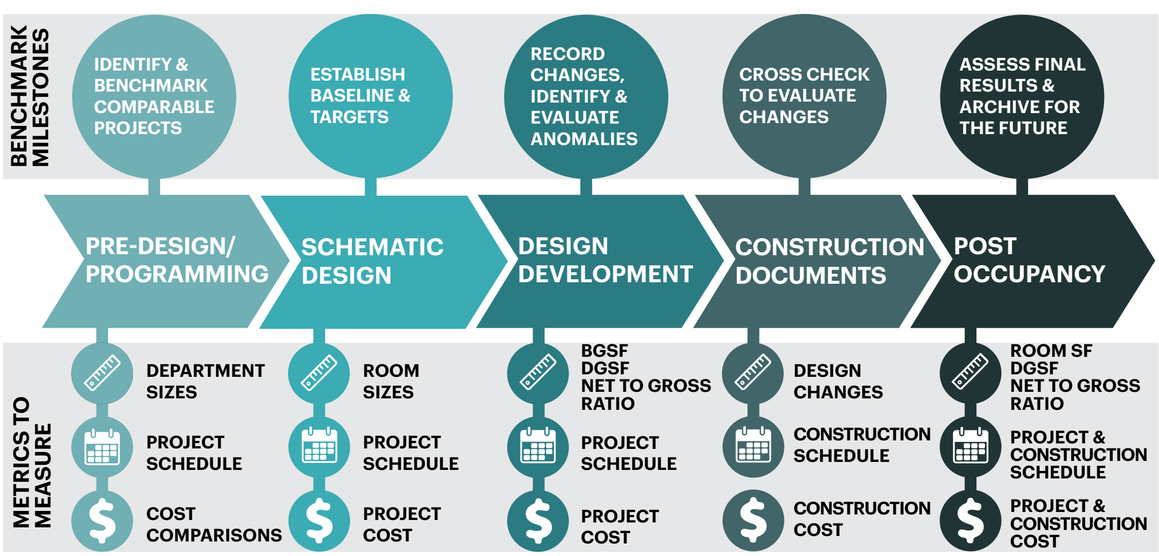


	Construction Cost / BGSF
Q1 - Q3	$484.76 - $801.70
Mean	$664.35

	Project Cost / BGSF
Q1 - Q3	$510.32 - $1032.08
Mean	$782.78

Construction Industry Institute health care benchmarking metrics
Image credit: HKS; Source: Construction Industry Institute

FIGURE 10



Project timeline with benchmarking milestones
Image credit: HKS

Conclusion

There is no prototype or "one-size-fits-all" solution for the patient room or inpatient unit. Healthcare facilities, architects, and care providers have differing preferences and ideas for the development of a facility that go beyond the published standards and recommendations. Additionally, third-party benchmarking practices are limited in standardization, validation, and data sharing, resulting in a need to invest in more industry-wide programs—particularly those with a design focus—to increase the data and knowledge available on the healthcare facility industry. The exercise of benchmarking facilities throughout the design process provides guidance and assurance that the design delivered is within acceptable ranges. When a facility's metrics lie outside of the accepted benchmarks, it is an indication to take a closer look and justify the reasons why the facility does not meet the benchmark. A series of checks and balances and examination from multiple perspectives will produce a well-thought-out solution suitable for the new facility.

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Open Rooms for Future Health Care Environments

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ABSTRACT

In recent years, many studies have revealed an increasing rate of hospital obsolescence, which reflects the velocity at which contemporary society and medical knowledge evolve. Recognizing this challenge, the main goal of contemporary and future hospital planning is to create flexible facilities capable of modifying and updating their services over time.

Many scholars and practitioners have already developed prefabricated and flexible strategies. Working from Professor Kendall's Open Building theorization (Kendall, 1999) and current applications of hotel facilities plug-in rooms, a multidisciplinary research group from Alta Scuola Politecnica has developed the Open Room approach, an innovative design solution that is able to adapt to changing needs. The Open Room is an innovative design approach able to adapt to changing needs.

The design approach is structured into three parts:

- the primary system, which consists of a main structural framework that can host open room modules
- the secondary system, composed of the sub-structural skeleton with all the installations of the module
- the tertiary system, which features both the furniture and prefabricated finishing panels that allow changes to the room's inner configuration and function.

The final product is a prefabricated room, transportable in three parts and able to accommodate a variety of fit-out changes. The interior space is defined by a series of customizable wall panels with foldable furniture and integrated functions, while the tri-partition of the substructures creates the possibility to remove the room and repurpose the building over time.

The research work defined the conceptual and technological framework for different ongoing studies on economic feasibility and possible market application.

Introduction

One of the biggest challenges for health care architecture is creating resilience to social, economic, and medical changes and developing health care services and assets able to meet the constantly changing needs of health care systems and their organizational models (Capolongo et al., 2015). The rapid evolution of medical knowledge and technologies often makes health care facilities unsuitable or even obsolete just a few years after construction. Scholars and experts involved in hospital planning are increasingly investigating new strategies to respond to these current and future challenges.

The most consolidated approach to the resilience challenge is to provide flexibility in health facilities. Flexibility is a building's ability to respond to service change in the short, medium, or long term, based on costs and user needs (Capolongo, 2012). For health issues, flexibility in hospitals should include a multiscale vision that ensures real efficiency of services provided through continually changing systems. Flexibility is critical from the planning stage, to the network system of local services, to the health care buildings that deliver services, to the mono-functional environmental units. All these layers should be structured with respect to organizational and managerial levels in an adaptive and resilient way (Astley et al., 2015).

Knowledge about flexibility in adaptability to service change has been developed and analyzed by scholars and professionals from different fields. They've found that flexibility can only be ensured by a building defined in the pre-design phase, according to technological, structural, and plant engineering criteria.

As a consequence, building adaptability has become essential for all operative and future hospitals. Current research in health care design has focused on highly-adaptable systems, from the technological to the structural scale and from the engineering building plant to the functional level (Buffoli et al., 2012). Moreover, several scholars and companies are developing strategies to improve the flexibility of significant spaces, which is essential to ensure quality for the growing demands (Verderber, 2016).

Contemporary hospital projects, often unsuitable to the needs of management and organizational complexity, are subjected to changes over time. It is necessary to define technical and technological solutions that help guarantee future changes will have minimal impact on the building systems and building users.

Among many design approaches, some experts are exploring the Open Building (OB) approach. Building upon John Habraken's studies, Stephen Kendall defined that OB is a constant surface flexibility strategy that embeds the ability to change and adjust to new layouts without increasing the building area. OB encompasses spatial and functional redistributions as well as attempts to design interior spaces, promising a high level of adaptability. By reducing excessive and useless dependencies and entanglements among components of the project, it is possible to ensure their operation without interference or damage to the others (Habraken, 1972). A preliminary distinction between durable elements and those that can be easily changed allows quicker, more affordable, and greater customization. This approach may be useful in dealing with fast changing regulations and strict bureaucracies that don't suit the design and construction timeframes of complex structures like health care facilities. For the application of the OB approach to hospitals, it is necessary to understand three systems: primary (structure), secondary (components), and tertiary (equipment) (Kendall, 1999).

State of the art

Several hospitals have been built throughout the world with prefabricated technologies. In the health care field, companies manufacture prefabricated products in two main categories: Plug & Play and Industrial, Flexible, Demountable buildings (IDF). Plug & Play relies on prefabricated structures—operating theatres and sterilization units—that are placed inside or close to the hospital. Plug & Play is a strong concept that can provide considerable savings in construction time, with tradeoffs in huge dimensions and a lack of flexibility. IDF is less expensive in production and transportation but requires longer assembly time at the construction site (Pilosof, 2005). IDF provides good flexibility with longer installation times and on-site assembly.

Starting from an understanding of OB, Plug & Play, IDF, existing strategies in health care-facility flexibility, and international know-how on prefabrication, our multidisciplinary team of Alta Scuola Politecnica (ASP) from Politecnico di Milano (POLIMI) and Politecnico di Torino (POLITO) developed innovative research on adaptability and flexibility in health care design.

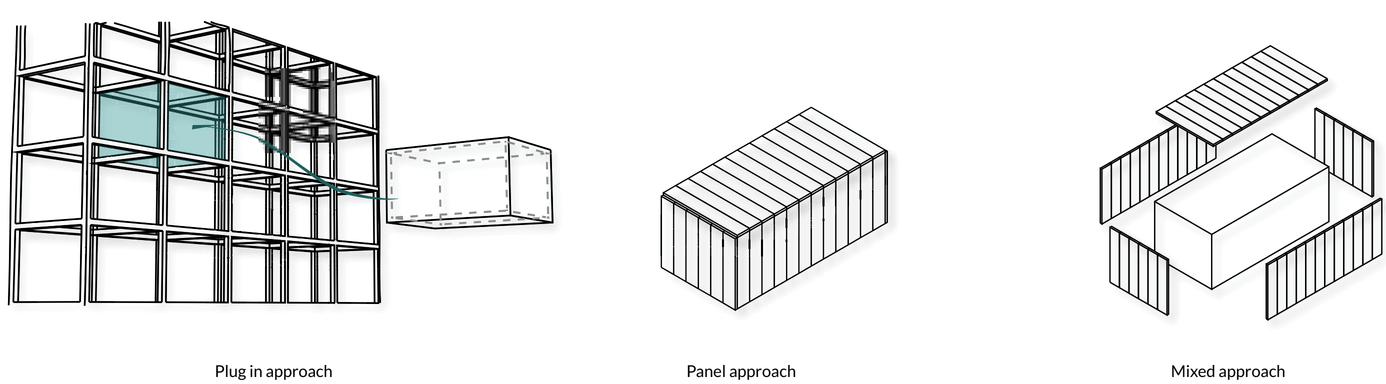
The Open Room (OR) guarantees maximum adaptability inside hospital wards with an original hospital planning approach and a prefabricated module system for healing environments.

Our research began with pop-up architecture; in particular, the prefabrication strategies for several hotel buildings. These facilities feature prefabricated rooms that were constructed in factories and plugged in during site construction (Di Pasquale, 2014). Although hotel rooms reflect specific organizational, logistic, and design needs, the layout of guest rooms is very similar to inpatient rooms. Therefore, the aim of this project is to define the conceptual and technological framework of a prefabricated healing setting application that can be plugged in and changed over time, always guaranteeing maximum efficiency of the health care facility.

Open Room approach

Starting from the OB concept, the research team focused on the small-scale room project, working to achieve a solution to address flexibility while enhancing the quality of care. To better understand the topic, the team attended lectures, international conferences, debates, and several site visits to international case studies in Groningen (Martini Hospital), Barcelona (Hospital del Mar and Hospital de Sant Joan Despí), Milan (Humanitas Clinical Institute), Bern (INO Hospital) and Chur (Kantonsspital Graubünden), each well-known for their flexibility.

FIGURE 1



Different approaches to flexibility.
Image credit: Open Building research group - Alta Scuola Politecnica

While new health care trends place greater emphasis on research and outpatient clinics, hospitals will continue to require inpatient wards, although residence time will continue to be reduced (Mauri, 2015). Beginning with the hospital room—like the hotel room—the research team began its early reflections on an inpatient room, classifying the differences. In some ways, hotel environments feature more advanced interior design and are focused on guest comfort and up-to-date technology and styles to meet contemporary market needs. The the critical feature of inpatient rooms is the space around the bed, used by users.

The Open Room concept development followed an iterative process, including input from scientific literature and interviews with health care experts. Collaboration with German-based international companies helped team members understand current and experimental technologies and techniques.

To facilitate installation, maintenance, and possible changes, we tested an approach that merged pre-built modules (Plug & Play) with the panels approach. The outer module became the container with the skeleton, connections, and installations (components), and interior finishing incorporated the panels, which become versatile, changeable, removable, and modifiable elements over time (equipment). In this scenario, the modules accommodate all possible technical needs and configurations of health care space while the finishing panels allow faster environmental transformation for the needs of the health care organization, both by a punctual modification and structural reconversion of a hospital ward (figure 1).

Driven by OB in health care, the Open Room approach can be described in three steps: Primary, secondary, and tertiary systems.

Primary system

The primary system, known as "base building," "core and shell," or "mother system," is the decision point with the longest utility value (Kendall et al., 2014). It includes the bearing structures, the main distribution, and the building plant system. The primary system can last more than 100 years and represents between 10–15% of the total investment. According to Kendall's studies, the main goal is to ensure the primary system can accommodate a variety of floor plans and equipment layouts over time. In other words, the structure should not be dependent on the secondary system.

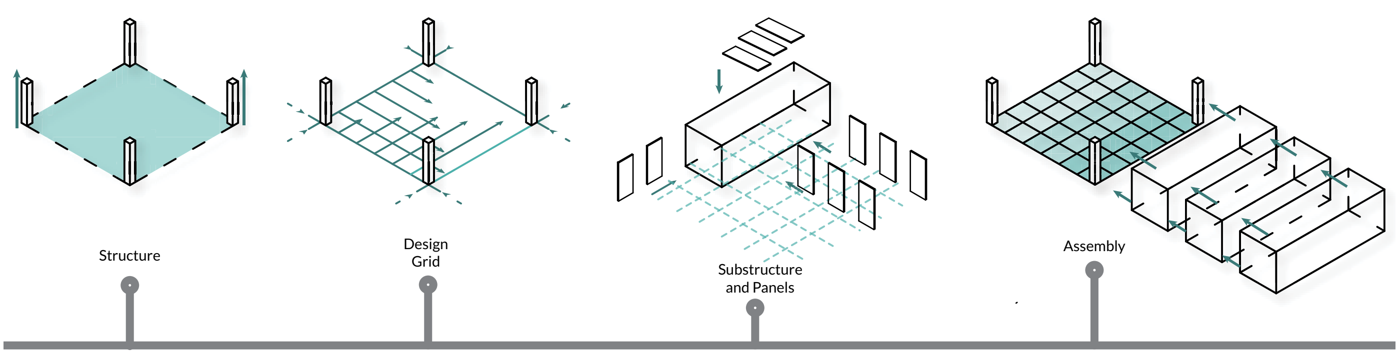
The structural grid must be regular and should guarantee maximum future flexibility for both predictable and unpredictable layouts. As OB theory states, it is crucial to understand and define maximum structure adaptability over time and, therefore, the dimensions that support several future scenarios, as the INO Hospital in Bern reflects in its layouts (Capolongo et al., 2016)

The analysis of several hospitals' furniture and spaces led to the choice of a 120 cm modular grid with exceptional submodules of 30 and 60 cm, as found in the Martini hospital. With this grid, each space can ideally accommodate an infinite variety of furniture and functions while maintaining a compact and non-fragmented feeling. The combination of these two basic elements helped define the structural frame as a rectangle of 6.90 x 8.40 m (interaxle), in which two single inpatient rooms of approximately 25–28 sq m can be hosted.

Secondary system

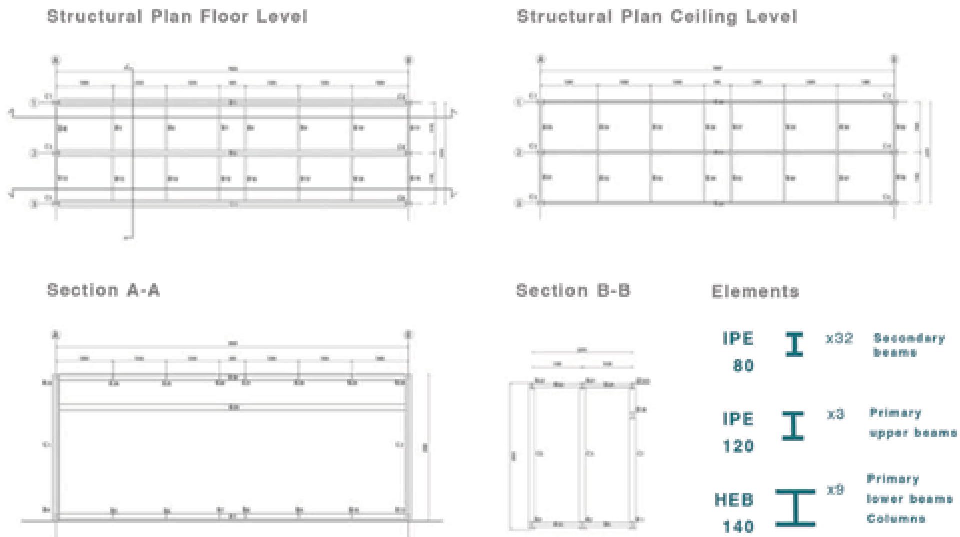
The lower level consists in the secondary system, known as "fit-out," which is fairly changeable without disrupting the base building or modifying the hospital ward dimensions or engineering plants. The secondary system generally includes partitioning, ceilings, and floor layers.

FIGURE 2



Open Room approach: Structure, design grid, substructure, and assembly.
Image credit: Open Building research group – Alta Scuola Politecnica

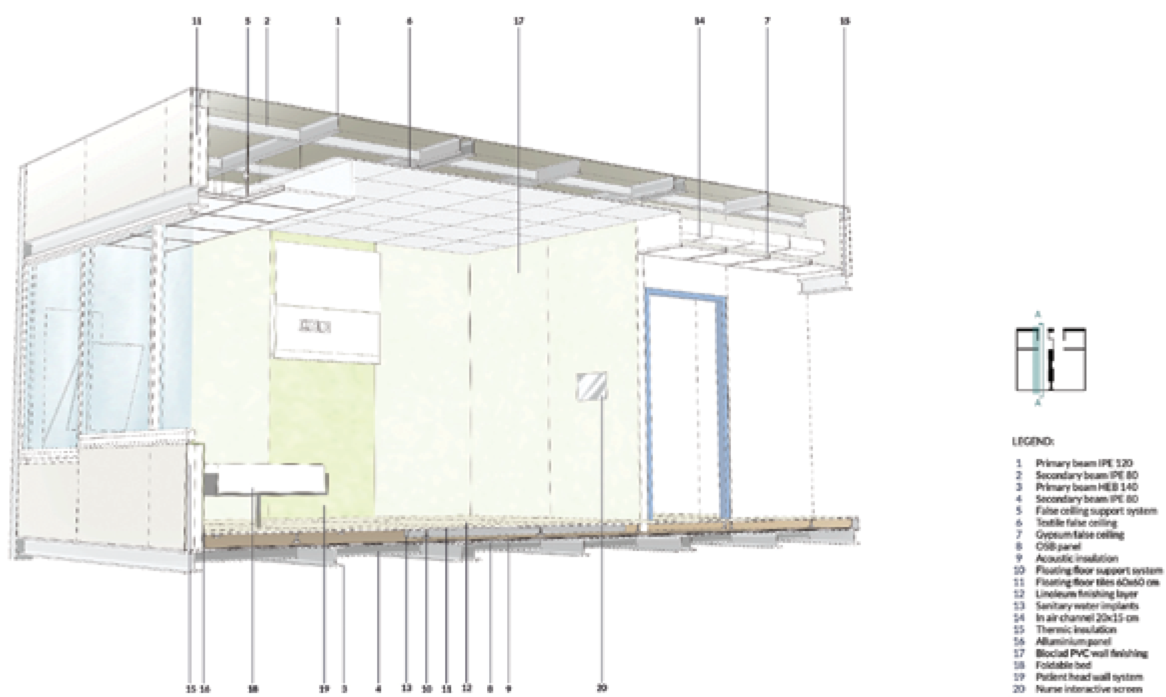
FIGURE 3



Module technical details

Image credit: Open Building research group – Alta Scuola Politecnica

FIGURE 4



Module technical details

Image credit: Open Building research group – Alta Scuola Politecnica

As Kendall et al. (2014) suggest in the OB approach, specific attention must be given to the provision of secondary-system components because it can be rapidly removed, repositioned, or replaced with minimal disruption to primary system. In the same way, changes made to the tertiary system, such as upgrades, replacements, or substitutions, should not excessively modify the fit-out level, which usually lasts for 20–40 years.

Although there are several hotel examples where guest rooms are already entirely plug-in, a plug-in hospital room is still far for from feasible. Unlike hotel rooms, hospital wards have several complexities that require attention to the implant design. Nevertheless, as shown in the primary system, the structural grid can accommodate two smaller rooms or one large room for each span. In fact, unlike hotels, hospital layouts have several functions and different room sizes, to guarantee maximum adaptability; the secondary system must host either one great space or two rooms.

For secondary systems, the main considerations are transportation, assembly technique, technologies, and engineering plants.

For transportation, current container approaches are limited by the fixed standard dimensions of a single unit, which are defined by European maximum allowable transportation dimensions (2.55 m x 12.00/16.50/18.75 m x 4.00 m). Starting from these dimensions, the design process led to the definition of three identical light substructural frames, equal to 2.40 m x 8.10 m x 3.30 m. The height of the frame was determined by transportation limits and truck dimension considerations, which allows the team to avoid exceptional transportation.

Each substructure is demountable and sustainable with a steel frame. In fact, the steel framing is a consolidated and common technology that allows for three substructures without any technical problem. Each frame is sustained by six columns bearing three principal beams of 7.96 m span on the top level and three on the floor level.

To distribute the load toward the primary structure and easily connect it to the substructure, the columns are welded to a steel plate in the factory. This connection should transfer the axial stress and the bendings. A fixed, bolted connection allows future disassembling of the substructure (figure 3). To support this connection, the primary structure should include ground anchors precisely positioned at the column base for connection to the steel plate with bolts fastened at the construction site. During the positioning, this technological choice keeps the substructure lifted from the slab of the primary structure through specific profiles that create a gap between the two systems to allow the removal of the wheels and the support. Through an integrated piston system, the movable support can be easily lowered and removed from the installation site.

This process—inspired by the growing tendency to place prefabricated bathrooms in health care facilities—can significantly reduce construction time. Moreover, it increases the safety of the work environment since the majority of building operations are performed in the controlled environment of an off-site industrial facility (Buffoli et al., 2012).

Additionally, the substructural frame is integrated with all the possible implants necessary for hospital rooms, including water, air, electricity, and gases. To guarantee maximum flexibility of space and functions, the secondary system designed considers all the functions that a hospital room may support due to future trends and modifications. For this reason, several focus groups were organized to investigate the different types of health care environments, analyzing all the needs and functions and defining the implant terminals positioning. In this perspective, the medical gas terminals, electrical, and data cables linked to the main implants distribution in the corridors, are well distributed in the room to allow reconversion without heavy implant modifications, if not for the finishing elements (tertiary system) (figures 5 and 6).

In addition, the substructures assume the role of secondary system for their complexity because they host the predisposition for all the possible implants. Even if this requires a higher initial investment, in a future perspective the solution allows maximum adaptability of the health care organization with time, cost, and organizational enhancements (figure 7).

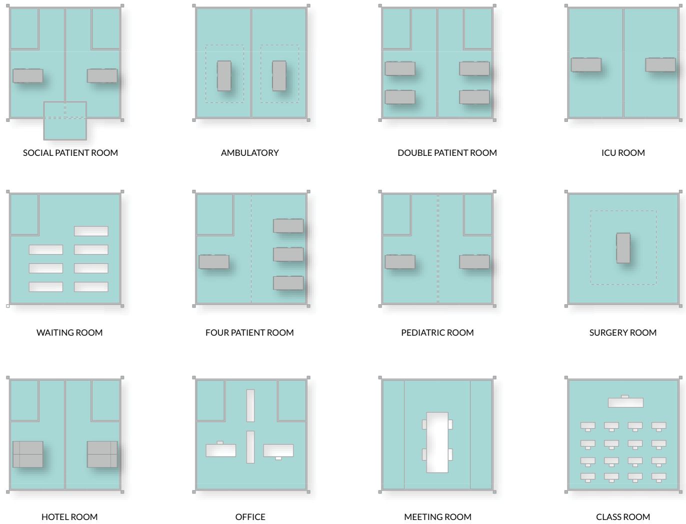
Tertiary system

According to the OB approach, the tertiary system—equipment—includes all the elements that are defined by IDF. Intensive use or rapid technological upgrades may require modifications within 5–10 years.

For the OR approach, the tertiary system is represented both by the furniture and, especially, by finishing panels. Working from focus group findings, the room's layout has been studied through an iterative process of design and verification from the conceptual to the detail scale to consider all the design parameters and user requirements affecting the design decisions. The dimensions of panels used are 30/60/120 x 240/270 cm, and they can create finishing elements that support several different functions based on requirements and general layouts (figure 7).

Current health care trends are toward increasingly shorter in-hospital recovery periods. Rather than foster an approach to transform hospital rooms into home environments (Scullica et al., 2012), it is better to adopt a series of small strategies to create a comfortable environment, while keeping a positive sense of temporality (Ulrich, 1992).

FIGURE 5



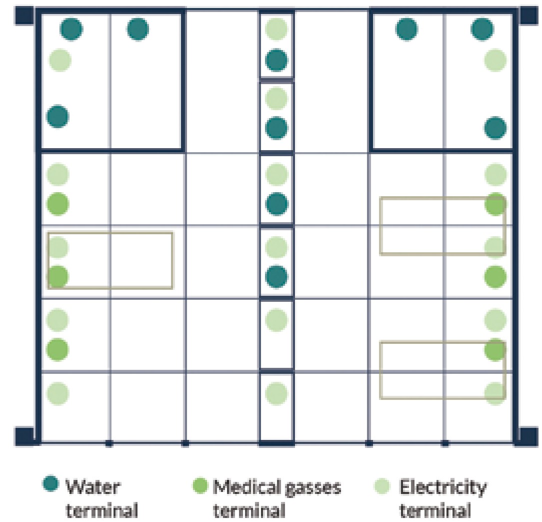
Open Room long-term reconversion scenarios
Image credit: Open Building research group – Alta Scuola Politecnica

After considering several configurations, we detailed the singular and double inpatient room layouts (figure 8), structuring them into three main areas thatcorresponding to three substructures: The service zone, the inpatient's core, and the family space (figure 9). The first area includes the bathroom and a space specifically devoted to nursing activities; a lower false ceiling saves space for implants. The second area, the patient's core, contains furniture and the panels that host functions related to wellness and entertainment, including panels behind the bed that host medical gases, reading lights, and electrical plugs. Finally, the third area, the family space, hosts visitors through several configurations (Del Nord and Peretti, 2012).

The ceiling is high and constructed of textile panels with customizable integrated lighting systems. There is a wardrobe for personal items, an interactive screen, and a small screen embedded in the bathroom outer wall to let doctors access information and data. The interactive screen can serve several functions, including personal computer, images of the outside environment, and medical descriptions.

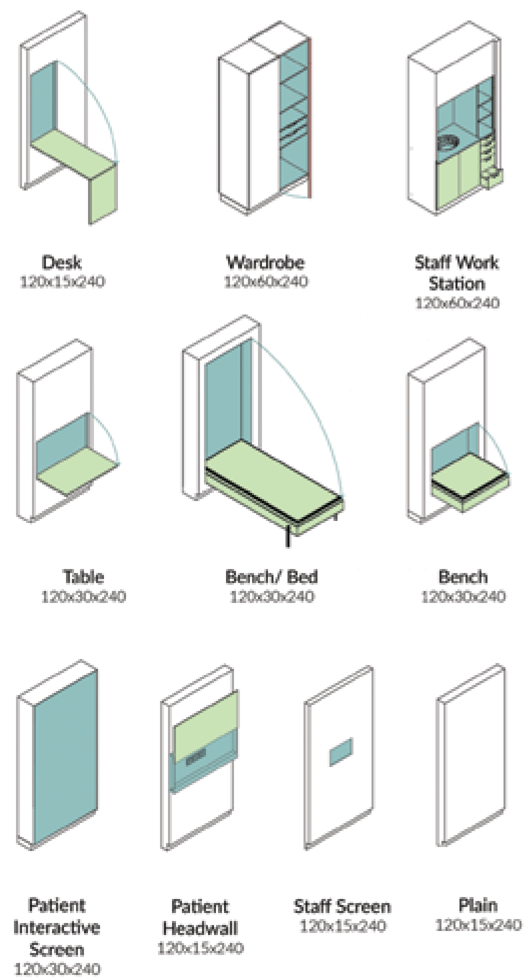
This study introduces Open Room methodological approach to flexibility, but the multidisciplinary background of the team members also helped detail hygienic, health care processes and organization, ICT, soft qualities, ergonomic, lighting, maintenance, and humanization aspects (Alfonsi et al., 2014).

FIGURE 6



Superposition of implants terminals
Image credit: Open Building research group – Alta Scuola Politecnica

FIGURE 7



Catalogue of all possible furniture units
Image credit: Open Building research group – Alta Scuola Politecnica

Perspectives

This research defines new perspectives in health care environment flexibility. By merging different fields, we achieved a multidisciplinary research outcome in which technology, layout and health care issues, social aspects, and soft qualities contributed to a final product easy to realize, fast to assemble, and well-integrated into the hospital life cycle. It also provides the opportunity to extend its lifespan by changing internal functions (Shepley et al., 2015).

The OR approach enhances operational sustainability, and it allows fast and safe changes in space and function in the short, medium, and long term. For short-term updates, flexibility is enhanced by the tertiary system's ease of panel replacement. For medium- and long-term changes in function, the module is composed of three substructures that can be unplugged from the primary system and quickly substituted and even recycled at their end of life. A similar approach was applied in Martini Hospital, Groningen (NL). In this way, it is possible to guarantee flexibility during the time. As Kendall states, a capacious container provides decision makers with good choices about what goes inside the health care facility (Kendall et al., 2014).

The layout configuration, soft qualities and materials, and the possibility of standard and/or premium customization all allow the OR approach to play a key role in enhancing users' wellness. Moreover, the adopted technologies allow the highest level of customization to support varying needs and constraints of different hospital facility managers. And, OR addresses flexibility as it enhances the quality of future health care environments.

Starting from this conceptual and technological basis, economic and market feasibility needs to be further investigated.

The Open Room is a technological definition of a prototype with a specific site approach to better understand the connection between the product and the whole hospital facility. At this stage, it is important to investigate the relationship that the OR has with different hospital ward layouts. In this direction, it is interesting to evaluate precautions and considerations while designing a hospital to host an OR system.

Moreover, an executive economic evaluation is crucial, one that includes close examination of the advantages and challenges in introducing a full OR production line into the current health care real estate market, taking production costs and selling margins into account.

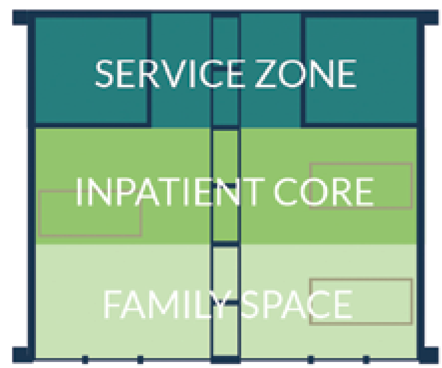
It is also conceivable to apply this approach beyond the western context and verify the social, economic, and environmental feasibility of using prefabrication in developing countries with or without implementation know-how. Further, application in existing hospital structures requiring renovation should be studied to evaluate feasibility in international contexts.

FIGURE 8

Module plan

Image credit: Open Building research group - Alta Scuola Politecnica

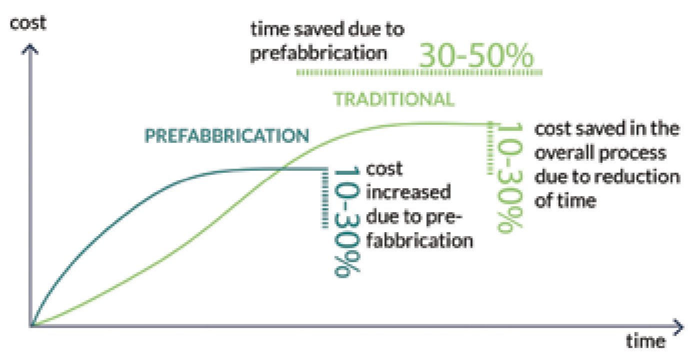
FIGURE 9



Room functional areas

Image credit: Open Building research group - Alta Scuola Politecnica

FIGURE 10



Comparison between prefabrication and traditional building technology

Image credit: Open Building research group - Alta Scuola Politecnica

Acknowledgments

The development of the research work was possible through the collaboration of several experts in the healthcare field.

Eng. Susanna Azzini, 3WHE teamwork, Milan (Italy)
Dr. Valentina Bettamio, Istituto Nazionale Neurologico Carlo Besta, Milan (Italy)
Dr. Gilberto Bragonzi, CNETO, Milan (Italy)
Arch. Arnold Burger, Dutch Hospital Design, Alkmaar (The Netherlands)
Arch. Margherita Carabillò, Milan (Italy)
Arch. Luigi Colombo, Gala spa, Milan (Italy)
Prof. Marta Conconi, Politecnico di Milano, Milan (Italy)
Prof. Fulvio Corno, Politecnico di Torino, Turin (Italy)
Mr Thomas Fritsch, HT Group, Heideck (Germany).
Arch. Susanne Glade, GO+architekten, Hamburg (Germany)
Prof. Yehuda Kalay, Technion, Haifa (Israel)
Prof. Stephen Kendall, Ball State University, Muncie (USA)
Dr. Maurizio Mauri, CNETO, Rome (Italy)
Arch. Nirit Pilosof, Technion, Haifa (Israel)
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Arch. Gabriella Ravegnani Morosini, Milan (Italy)
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Arch. Alvaro Valera Sosa, TU Berlin (Germany).
Arch. Lars Steffensen, Henning Larsen Architects, Copenhagen (Denmark)
Arch. Andrea Zamperetti, Salini Impregilo, Milan (Italy)

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Songambele Stories

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ABSTRACT

Built in a region of limited resources, the new Songambele Hospital seeks to leverage its most important commodity, community, to create sustaining health in the village of Nkololo and the surrounding region. Just miles from the famed Serengeti National Park, over the last seven years, the small, overcapacity and underequipped dispensary has been transformed into a full-service hospital through the Roads to Life Tanzania team. Opened last year, the surgical building reduced the travel time for Nkololo women needing emergency C-sections by over an hour, while the Songambele lab building is transforming the way the village fights malaria.

Equally transformative, the Songambele workshop and trade school is empowering men and women in the community to trade sweat for skills training and the opportunity to transform their communitythrough a dignified approach to job creation. The creation of the hospital master plan has impactful stories of dignity, empowerment, life, and redemption woven into it and makes a powerful case that the only path to long-term sustainability for health care systems is to invest in people.

Introduction

The dream

In 2010, as a graduate student at Texas A&M University, I was connected with Father Paul Fagan and Roads to Life Tanzania through Professor George Mann. It was a once-in-a-lifetime partnership for a young architect wanting to directly impact the world through his pen and trace paper. The dream was to expand a 10-year-old, overcapacity dispensary in the middle of a remote Tanzanian village into a full-service hospital.

FIGURE 1

Songambele Hospital Site Plan
Image credit: Southern Ellis

In an effort to truly understand the complexity of the project, I travelled to Nkololo to spend time with the dreamers envisioning the new facility and the community the project would impact. Father Paul introduced me to the village and provided valuable insight from his many years of construction experience in the region.

Most of my first trip to Tanzania was spent with Dr. Helena Sidano, a young doctor who explained the nuances of Tanzanian health care delivery, a drastic departure from health care in the western world. Equipped with notebooks of evidence-based design knowledge I had absorbed from my A&M professors, Dr. Mardelle Shepley, Kirk Hamilton, and George Mann, we sketched a master plan for the hospital. Later, renderings were created for fundraising efforts to sell the Songambele dream.

We saw the hospital as a catalyst of healing for the region. No longer would men and women die on the rough, unpredictable dirt road to the next closest hospital. We would bring health directly to the heart of Nkololo through the Songambele Hospital. Beyond health, though, the hospital would be the largest construction project ever attempted in the village. Harnessing the opportunity to positively impact the region's economy became a key project driver. Early on, construction skill building and job creation were necessities to simply get things built. As the project has continued to evolve, it's apparent that this investment in our community brings beauty and strength to the tapestry of the hospital by adding layers to the interwoven stories that make up the Songambele Hospital narrative.

Story of lights

Seven years after my initial trip to Nkoloko, I found myself standing alongside my wife in front of an idling flatbed delivery truck as its headlights shined into the Tanzanian acacia trees. Atop the truck, seven-foot-tall wooden crates stamped “Songambele Hospital X-Ray” signified a new season of healing at the village of Nkololo. But while the arrival of new medical equipment to a remote hospital should bring excitement, there was anxious uncertainty in the air on this dark evening. There are complexities to health delivery and sustainability in the developing world, and today’s complexity was the utter lack of a forklift—a necessity for unloading the wooden crates in front of us.

Beams of light from all directions began to illuminate the crates. The spheres of light grew larger and larger, dancing on the wooden X-ray crates as a crowd of men with flashlights approached. Men from across the village had come out of the woodwork to lend a hand and assist with this important delivery. Before I knew it, we were hand in hand, lifting the prized equipment off the flatbed and into the Songambele facilities. Although I couldn’t understand a word these Nkololo men said, their eyes and their actions spoke volumes. They weren’t there, in the dark of night, to lift an X-ray machine; they were there to lift the health and future of their beloved community.

Hours earlier, my wife and I had experienced another light-saturated scene inside the newly opened Songambele surgical building. This time, tandem beams of the theater’s new surgical lights illuminated a basketball-sized tumor growing from a young lady’s abdomen. Framed by a blue surgical cap and mask, the eyes of Songambele surgeon, Dr. Kidando, were beacons of focus, intensity, and skill, as his scalpel brought miraculous healing to this young woman from Nkololo.

These two stories demonstrate the multifaceted impact of the Songambele Hospital. A narrative of healing has been layered with an equally powerful narrative of community investment and inclusion. Each of the stakeholders involved in the project—community members, patients, medical staff, builders, architects, and investors—is playing a role in the life, health, and empowerment stories of Nkololo.

Story of health & community

The master plan for the Songambele Hospital is quite different than the congregated massing schemes seen in large hospital towers around the world, where mechanical and electrical resources are plentiful. In a region such as Nkololo, mechanical ventilation and artificial lighting are a luxury. Designed as a series of narrow buildings connected with covered walkways to accommodate natural ventilation, access to natural light, and to allow for phased construction as fundraising milestones are met, the Songambele Hospital campus brings life and healing to a community that was once devoid of medical care. Provision for this phased construction is often a necessity in the developing world since it allows manageable fundraising goals to be set to prioritize and deliver care according to the specific health issues of the region.

FIGURE 2

Southern Ellis with Dr. Helena Sidano
Image credit: Southern Ellis

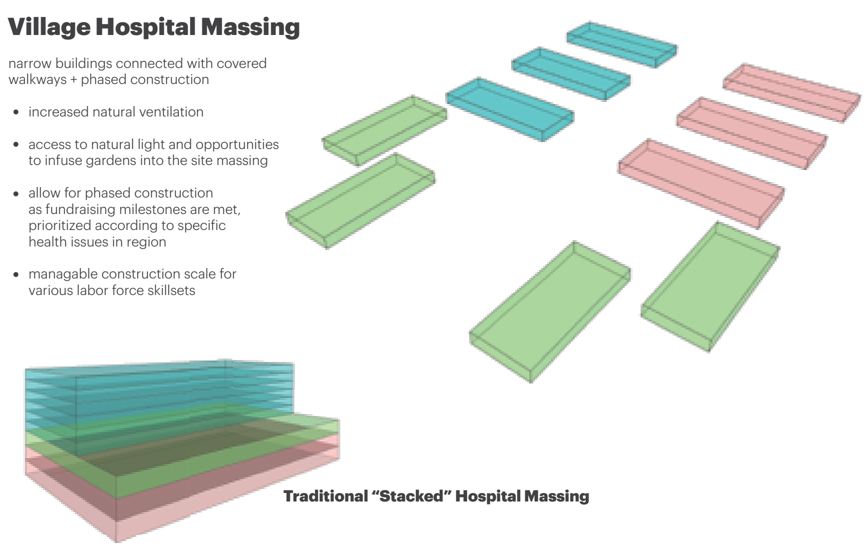
Nkololo is located about an hour motorcycle ride via rough, unpredictable dirt roads from the next-closest hospital facility. For many in Nkololo and the surrounding regions who found themselves needing emergency care, this hour-long trip often proved deadly. Home births assisted by local midwives are the norm in this region, but when complications arise, immediate care is a necessity and access to a sterile operating suite to perform a C-section is crucial. The Songambele Hospital surgical building, which opened in the summer of 2016, provides this capability. In its first year, 326 surgeries were performed in the surgical building, including 102 C-sections. It’s easy to glaze over statistics, but in the context of impact, each successful surgery and C-section means that the story of someone from Nkololo is forever changed.

The Songambele lab building is fighting to change the story of the leading cause of death in the region: Malaria. Completed in 2013, the Songambele Lab became the first lab in the extensive Shinyanga and Simiyu Regions of Tanzania to be permitted by the Tanzanian Ministry of Health to give blood transfusions. Blood transfusion capability allows the hospital to attack malaria head-on.

FIGURE 3

Surgeon Dr. Kidando within the Songambele Hospital Surgical Building
Image credit: Southern Ellis

FIGURE 4



Village Hospital Massing Concept
Image credit: Southern Ellis

FIGURE 5

Outside the Songambele Hospital Ward Building
Image credit: Southern Ellis

FIGURE 6

Songambele Hospital Ward Building Interior
Image credit: Southern Ellis

New inpatient wards supplement the lab and surgical buildings. These wards are filled with donated beds, locally manufactured side tables for patient belongings, and patients on the road to health. While limited air conditioning capabilities are provided in the operating rooms within the surgical building, the wards are designed to harness prevailing breezes through natural cross ventilation. Artificial task lighting powered by solar panels adjacent to the buildings supplement natural light flooding through the windows of the wards.

Through our work over the years, we constantly listen, observe, and adapt to cultural aspects that affect the way we deliver care. As we designed the campus master plan, we knew family was at the center of everything happening in the village. When a sick patient arrives at the hospital, they are often accompanied by multiple family members. Often, these family members act as assistant caregivers throughout the patient's stay at the hospital, which is important in a region hampered by medical staff shortages.

Outdoor seating areas with direct line-of-sight to patient beds are provided for families just outside the ward buildings, allowing these secondary caregivers to remain close to loved ones. While visual connection is maintained, this approach also provides a slight physical separation from the treatment zone to control the potential spread of infection and provide space for the medical team to work within the ward.

This year, the facility's Mother-Child Health Clinic will open its doors, providing outpatient care associated with reproductive health to the region. Adjacent to the new Mother-Child Health Clinic, a partnership with Medici Con L'Africa (Doctors with Africa CUAMM) assists with the delivery of a Center for Disease Control (CDC) building on the campus. An Italian physician with a specialization in infectious disease is already on-site in preparation for the CDC building's opening, marking a multiyear partnership to train local medical professionals to treat and council those affected by infectious diseases such as AIDS. This partnership also assists with improving public health, preventive health, and community outreach initiatives at the hospital.

In Nkololo and the region, hospitals are often seen as a last resort for the very sick, rather than a place of health promotion. Many villagers choose to avoid the hospital during times of illness or pregnancy complications until it is too late. While all of these programs are great, they will not be utilized without community buy-in.

A critical factor in community outreach has been the fact that the campus has been embraced by the community. An entry courtyard bordered by the Mother-Child Health Clinic, the CDC, the lab building, and the old dispensary, invites the community of Nkololo into the facility. Every day, men, women, and children flood into the hospital's courtyard to sell fruit, catch up, and watch the ongoing construction. Some are there with patients; most are there because they see the hospital as the new epicenter of village activity.

From a public health standpoint, we have ideal access to the very population we are trying to serve and can build familiarity and trust among our patient population. With the walls of the hospital open, we have access to seamlessly educate future mothers on healthy delivery practices and young mothers on potential infant-health danger signs. We have the ability to educate the community on nutritious eating habits or disease prevention practices. Most importantly, with people flooding daily into the hospital's courtyards, we know the community feels a sense of ownership towards the facility.

Helena's story

Born into a country where education for young girls is an afterthought, the story of a woman named Helena is one of the beautiful threads woven through the Songambele tapestry.

FIGURE 7

A mother and daughter wait within the Songambele Clinic
Image credit: Southern Ellis

Due to the cost of education, many families in rural villages like Nkololo can't send all their children to school. This hardship is often coupled with a prevailing cultural view in the region that when married, girls become the property of their husband. This leads many families to view investing in the education of their sons as a smarter investment than paying to educate their daughters. This leaves many young girls uneducated beyond minimal primary schooling.

Seeing this phenomenon, Roads to Life Tanzania began to combat the issue by raising money to send young girls like Helena to upper levels of education. It turned out to be a great investment. Seven years ago, when I travelled to Tanzania for the first time to begin designing the hospital, it was Dr. Helena that returned to her home village to teach a young architecture student about Tanzanian health care. Today, Dr. Helena leads the medical team as head physician of the Songambele Hospital. Empowerment and redemption are at the core of the project and the goal behind everything that we do.

Story of dignity

The bricks of the Songambele hospital are formed on-site, steps away from the hospital's construction. The team collects sand from the river that runs through the village. Onsite, the sand is mixed with a little cement, water, and a secret ingredient for added strength: Sweat from men and women of Nkololo. It's this local sweat, rooted in job creation and empowerment that serves as an agent of dignity.

Perhaps one of the most impactful stories interwoven into Songambele is the story of the construction workshop and trade school, which has employed hundreds of men and women over the course of the hospital's construction. In remote agriculture communities like Nkololo, the only available career choice was that of a small-scale farmer struggling to make ends meet. The Songambele construction trade school provides a dignified approach to job creation that allows people to not only invest in themselves, but also in the future of their community. The Songambele workshop provides on-the-job training, creating the master welders, carpenters, and masons that will continue to go forth and transform the community of Nkololo long after the hospital is finished. This is the story of development as a portal for sustained economic growth and that meets the needs of a community, while also creating the framework for the community to continue to transform itself.

Investing in people to sustain growth isn't limited to the construction process; it also filters into the programmatic elements of the master plan. Many developing countries suffer from a shortage of trained medical professionals, and Tanzania is no exception. This shortage is compounded in rural tertiary hospitals, which struggle to compete with district hospitals in larger cities for qualified doctors and nurses.

For physicians like Dr. Helena, returning to her home village and lifting her community might provide enough incentive to practice in this remote region. For others, though, more incentive is needed. Anticipating this, several beautiful staff houses have been built on the grounds of the hospital to incentivize the best and brightest in Tanzania to bring their talents to Songambele. The hospital has also invested in several village houses, outside the walls of the hospital, to house key medical personnel and provide temporary housing for visiting doctors from abroad.

Beyond housing, the Songambele master plan includes provision for the creation of a nursing school on-site, which will attract students from across the region and ensure a steady stream of nurses available to treat the hospital's growing patient population. Detailed design for the school and associated nursing student housing will begin later this year, with the goal of adding another cord of sustainability to the Songambele arsenal of impact.

Through design, we are trying to create a facility where physicians and nurses want to work. Healing gardens filled with blossoming red flamboyant trees provide a place of respite for staff members, and help reduce stress from the chaos of the hospital. The campus of narrow buildings allows for a multitude of exterior windows to bring natural light deep into staff work areas and patient treatment areas. Between the buildings, flourishing flora and fauna, immaculately manicured by the local groundskeepers, provide opportunities for patients, staff, and visitors to access nature, reducing stress and shortening healing times. This commitment to bring nature onto the campus reflects a direct investment in caring for our staff and the patients that enter our walls. It brings dignity to the healing process and dignity to the lives of the medical professionals that choose to spend their days serving others.

Our story

If you are reading this article, you probably understand the role architects play in the creation of effective healing environments. But I believe architects also have a responsibility to serve adjacent roles for our projects. One such role is narrator for our projects, speaking to and pointing out underlying storylines that can be missed by the casual observer. In the narrator role, architects become play-by-play announcers, interpreting the action from the field to an audience of potential donors or investors. This role is critical for projects in the developing world, where funding is tight. We advocate for the stories we see, and our enthusiasm can spark change.

FIGURE 8

Nkololo women within the Songambele Hospital community courtyard
Image credit: Southern Ellis

FIGURE 9

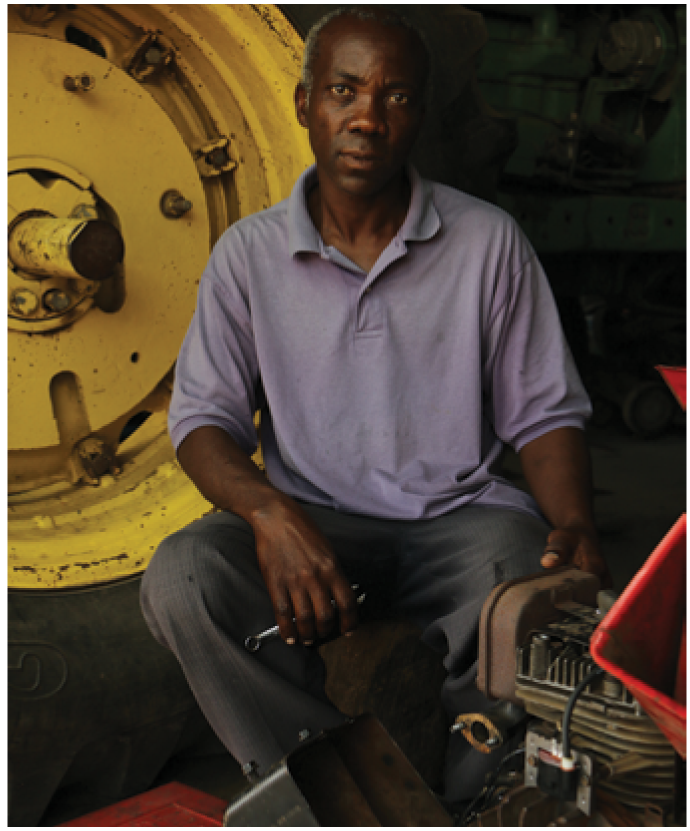
Dr. Helena Sidano with a patient at Songambele
Image credit: Southern Ellis

We also need to remember that we are not merely narrators; we are also participants. Our stories are interwoven into the communities we interact with and the clients we serve. My story changes every time I experience evenings like the night our X-ray arrived or as I begin to understand a different facet of Dr. Helena's story of redemption. I'm changed every time I see a mother nestled next to her newborn child or the faces of the Songambele construction crews as they create a brighter and healthier future for their children. I'm a different designer, listener, and person because my story is stirred into these stories.

But our most important role is not as narrator or even participant. We are also influencers of stories. We have the ability, duty, and responsibility to not only tell stories and be changed by stories, but also to impact stories.

The pieces of the Songambele Hospital tapestry create a story that is about more than bricks and architecture; it's about people. The Songambele story is about healing, life, empowerment, job creation, dignity, and redemption. These are stories that echo in communities for decades, and teach us that sustainability is forged by investing in people.

FIGURE 12



Songambele Workshop and trade school
Image credit: Southern Ellis

FIGURE 11

Welder within the Songambele Workshop and trade school
Image credit: Southern Ellis

FIGURE 10

Brickmakers within the Songambele Workshop and trade school
Image credit: Southern Ellis

FIGURE 13

Peter, a patient in the Songambele ward, and his mother
Image credit: Southern Ellis

Call for papers

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You are invited to submit articles, innovative project case studies, completed research projects, and monographs in the field of healthcare design. In addition to the architectural profession, all other disciplines involved in healthcare are encouraged to submit (doctors, nurses, administrators, etc).

Articles should be timely; preview new trends; and address industry wide topics, issues of relevance, and emerging technology in the healthcare system. No book reviews, please.

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