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Planning and Design of Progressive Healthcare Facilities

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Abstract The planning and design responses to the challenges facing the healthcare clients are progressive 21st century facilities that are not designed as machines that rely only on technology but rather integrate a diversity of characteristics, including the systems of the natural environment, to complement innovative and advanced environments.

Keywords Future Embracing, Design with Patients in Mind, Medical Home Model, Translational Laboratory

1. Hospital: 'Future Embracing'

The pace of change is accelerating and that every medical and technology breakthrough can bring new requirements. We shall also anticipate that once separate discipline will merge and become synergistic, thus removing divisions that have long been accepted as a fact of hospital life.

To take account of unforeseeable changes, we shall emphasize openness and flexibility, planning and designing a technologically smart building with the capacity to be upgraded. We shall save space by clustering related activities on a single floor, or by stacking them in vertical cores to concentrate services. But we shall also design to ensure that most of the rooms can be readily adapted to different purposes.

The Emergency care services departments shall be grouped on the ground floor, with bed-sized trauma elevators to transport patients from rooftop helipads. Operating and other Interventional rooms are most optimal to be concentrated on a single floor with mechanical services on the floor above.

Patient rooms shall be clustered in "pods" around the perimeter of the building. Ideally all rooms shall be private, and a generous size, allowing many procedures to be conducted in the rooms using sophisticated equipment, and providing a convertible sofa a friend or relative to sleep on.

Each of the elevators shall be dedicated to use by patients, medical or service staff. Patients and visitors shall circulate in the "front of house", leaving the stage and rear of house to staff.

Unlike an office, which can be laid out in radically different ways, the choices are limited in organizing a hospital. Proximity is a crucial issue.

The new hospital shall be planned and designed to be functional as well as environmental and aesthetic sense to *articulate* the inpatient bed blocks and the diagnostic & treatment podium, *breaking up the mass of the building and pulling natural light into the building.*

The breakthrough design shall create the illusion of several smaller hospitals instead of a single overwhelming structure; and patient room windows shall not look directly in on each other - The aggressive transformation of the traditional square floor plate into one where natural light can be harvested and focused to public and staff areas.

Light defines space. Light also affects the human body. It's tremendously important to experience the natural cycle of light and dark and to be wheeled out in the sun. Visitors used to be closely regulated; now they enjoy 24-hour access to loved ones as a right and we shall provide them with space and privacy.

Another key feature advocated by doctors who want spaces that would generate "chance encounters" among their peers, fostering a free-flowing exchange of ideas without having to wait for a scheduled meeting. We shall design a grand staircase for just that purpose, putting corridors around the outside perimeter of the building wherever possible. An enclosed corridor is like a tunnel and one speed along it. But one may linger in a corridor where one can see out, and if there's a wider bay and the sun is streaming in.

We shall create a "digital hospital" employing the most advanced computer technology to share the benefits of medical practice with everyone in the building, and with hospitals and schools across country and around the world.

2. Design with Patients in Mind

The new hospital shall offer an environment specifically designed with patients in mind. The new hospital shall use natural light, therapeutic colours and distinguishable finishes to assist way finding and provide a restful, relaxing environment. The rooms shall have daylight and views to ensure patients are in touch with the outside world, even in the basement areas. Consideration shall be made to ensure

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high levels of infection control in the clinical rooms and reception areas including anti-bacterial finish; and ledges and protrusions shall be kept to a minimum.

For Children, we shall create a cheerful and reassuring environment for sick and injured children and their concerned families. The Hospital shall have its own distinctive entrance for paediatric patients designed to be inviting to children with an interactive welcome wall. A large terrace on the pediatrics floor shall be provided to allow children direct access to the outdoors. Patient rooms shall be designed to benefit from an abundance of natural light and a sense of plentiful space with large windows that overlook gardens, green spaces and gathering places.

The pediatrics nursing floors shall address the social and emotional needs of children and families in the hospital with design features – so specialists can provide individualized therapeutic intervention, play and educational programs. The building design shall incorporate the beauty of the outdoors and sunlight into the space to enhance the healing process.

Multiple age-appropriate playrooms and a family resource room shall be provided and extend to a large outdoor play terrace with therapeutic views. The outdoor area shall be designed to allow children to safely play in the open air and enjoy the healing effects of natural light. A multi-media room shall be provided on the pediatrics floor to give teens a special place to play video games or watch movies.

Each pediatrics nursing unit shall have its own minor procedure room so young patients can undergo certain treatments away from their sleeping are to avoid associating pain or distress with their own room. Spacious patient rooms shall feature large windows with therapeutic views and a window seat with a daybed so family members can comfortably spend time in the room. To help ease the anxiety of sick and frightened children, the Emergency Department shall also feature pediatric-friendly exam rooms with murals and decorated ceiling tiles.

The new progressive hospital shall represent a whole new level of hospital design that will keep the Institution on the leading edge of medical science and patient care delivery.

2.1. ICU

Patient bed shall be placed in the middle of the room and all the equipment shall be located on the service boom, which hangs from the ceiling. The concept shall be 360-degree access so that patients can be treated easily from all sides. ICU rooms shall be also equipped to perform minor procedures right in the room I the case of an emergency, without having to move the patient. In the event that the patient needs to be moved, the ceiling boom shall have an equipment arm and portable trolley with battery that detaches and can go with the patient, saving critical preparation-for-transport time.

2.2. Nurses' Station

Here, all information shall be managed electronically, including patient charts.

In the back, the wall-mounted pneumatic tube system shall be provided, which carries materials to labs downstairs, the main pharmacy and even across the street.

2.3. Typical Patient Room

(Ideally) All patient rooms shall be private and feature windows that offer panoramic views and also bring in an abundance of natural, healing light. Window seats shall be able to convert to daybeds, allowing family members to room-in with patients. Data ports and wireless internet access shall be also built in so that patients and their guests can bring laptops.

Unlike typical patients in traditional hospitals, (ideally) these rooms shall be equipped like ICU's just in case the patient's acuity changes and the need arise for him/her to receiver more critical care. The headwall of the bed shall be equipped with medical gases, physiological monitoring capability, multiple data ports, lots of power, oxygen, air and vacuum, and everything one would need to care for a critically ill patient. This makes it possible for patients to be stabilized in their own room rather than being transferred to the ICU, should they change acuity.

Maternity rooms, like this one, shall be private and feature their own bathroom and shower and family area where one guest may sleep over. Each room shall have a bassinet where the baby can remain the entire time.

2.4. Labour and Delivery

Labor and Delivery Rooms shall allow mothers to give birth and recover in a comfortable, home-like setting where wood-paneled cabinets store all medical supplies.

At the time of delivery, a hidden light drops down out of the ceiling and the room shall be easily transformed into an efficient operating room, allowing mothers to give birth in the same bed. The specialty beds shall be also covert into seating or squatting positions for the comfort of a laboring woman.

There shall be bathroom with shower in each room and an area where family can sleep over. Adding to the comforts of home shall be TV, radio and small refrigerator for family use.

2.5. Pediatric Patient Room

Pediatric patient rooms shall be designed with children and families in mind. The private rooms shall offer a day bed and reclining chair for caregivers covered in child-friendly colors. Each room shall be equipped with a flat screen TV, DVD player and wireless internet capabilities. Picture glass windows shall emit sunshine in the room, creating a healing environment for the entire family.

2.6. Child Life Playroom

Hospitals can be confusing and frightening environment for a child. Child Life Specialists shall share the mission to promote optimum development, and minimize the impact of

traumatic events encountered by pediatric patients and their families along the continuum of family-centered-care.

The Child Life Playroom shall offer a child-centered approached to therapeutic play, allowing young children to explore the hospital environment through arts and crafts activities, dramatic play, and games. The playroom shall be an oasis from medical procedures, a place where children may travel to fun places in their imagination, safe from invasive medical procedures.

2.7. Child Life Teen Room

Child Life/Child Development Services shall recognize the unique qualities of adolescents and their experiences during hospitalization. The Child Life Teen Room shall be an interactive oasis where teens may engage with peers on line at the computer bay or compete with friends on one of the gaming systems Child Life Specialists shall facilitate creative arts activities where adolescents may create scrapbooks, pottery or jewelry, share in karaoke, or relax with a game of cards. The Teen Room shall provide countless opportunities for adolescents to express their personalities, feelings, interviews and goals in a relaxing environment.

2.8. Interventional Floor

The entire floor of the new hospital shall be dedicated to interventional procedures, reflecting the collaborative vision of Institution's medical professionals for the future of surgery and medicine. The blurring of disciplines shall inspire versatile design enabling surgeons to uniquely communicate within and beyond their operating room to achieve a higher level of connectivity and efficiency. Institution shall be able to offer surgical techniques that are minimally invasive and maximally effective.

2.8.1. Surgical Suite

With an overall design concept of "any care in any room", the integrated operating rooms shall be reconfigured for the appropriate operation. The large operating rooms more effectively use space and give surgeons the control over the operating environment.

The ceiling booms shall hold all the equipment, thus removing floor-mounted equipment and allowing a more efficient use of space.

The room shall be equipped with camera feeds and monitors. Using voice-activated controls, surgeons shall be able to select from multiple camera feeds, annotate over images, record the procedure on DVD, control all lights, bring up patient data and images, and even participate in a video conference during surgery.

All data collected during a procedure shall be displayed on any monitor within the operating room and shall be transmitted to other facilities worldwide.

Technologies and functionalities shall include:

- **Built-in touch panels and voice activated command systems:** Multiple flat screen panels and a large plasma screen shall feature telestration capabilities and voice-activated controls, which allow surgeons to select from multiple camera feeds, record the procedure on DVD, control the room and surgical lights, adjust the operating table, bring up radiological images and participate in a telephone call during the procedure.
- **Booms:** Jumbled networks of cables shall be housed within ceiling-mounted booms that can be pushed into positions or pulled out of the way when necessary. Each piece of surgical equipment shall be plugged into the same audio visual management system to increase organization and space efficiency.
- **Remote video conferencing:** Audio, video and data communications between two or more sites shall support education and collaboration. Several room cameras, a boom-mounted camera directly over the operating field and digital output from endoscopic cameras shall allow medical students, residents, nurses and visiting surgeons to observe surgeons perform procedures from remote locations.
- **Room-to-room audio and video communications:** Wireless microphones and ceiling speakers shall allow private or public hands-free conversations to take place. Surgeons shall be able to collaborate with other healthcare professionals while performing surgeries and get immediate access to required information without interrupting the procedure.
- **Information management:** Any data, video or text in the hospital network, such as patient histories, lab results and diagnostic images shall be able to be accessed and imported into the operating room and displayed on high-resolution monitors.
- **Teletration:** Surgeons shall be able to annotate over any displayed images on the operative screen for collaborative interaction and interpretation. The images shall be able to be broadcast to local and remote destinations or archived for future reference.
- **Intra-room connectivity:** All data collected during a procedure – voice recordings, radiology scans, patient data, images from endoscopic cameras – shall be able to be displayed on any monitor within the operating room. The same images shall be able to be transmitted worldwide.
- **Video capture and data archiving system:** Any image captured or sent into the suite shall be able to be recorded for post-operative review. The archived data shall be able to be used for teaching or consultation purposes and shall also be accessible from remote locations. Images shall be able to be added to a patient's electronic medical records as well.
- **Computer and device control:** All electronic devices within the surgical suite shall be able to be controlled from single or multiple points within the operating

room. With new internet-accessible technologies, controls shall be able to be extended to any location via the Web.

- **Native resolution:** The images collected within the operating suites shall be able to accept and distribute the full range of signal formats most widely used for high-quality imaging such as Serial Digital Interface and High Resolution Computers.

2.8.2. Intraoperative Imaging Suite

Intraoperative Imaging Suite combines operating rooms (ORs) with state-of-the-art imaging technologies, co-locating both MRI and CT modalities in a comprehensive suite.

The suite shall be consisted of an intraoperative magnetic resonance imaging (IMRI) device that runs on a ceiling-mounted rail between two ORs, with a garage at the center which can be used for diagnostic imaging when the magnet is not in use for a surgery. Across a shared control room, two additional ORs shall be configured on either side of ceiling hung intraoperative computed tomography (ICT) device, housed in another garage at the center which can be used for diagnostic imaging when the computed tomography is not in use for a surgery. This will enable surgeons and radiologists to collaborate, creating better outcomes for patients.

Merging surgery with imaging allows surgeons to evaluate their work while the surgery is in progress, and decreases the chance of repeat surgeries. With the integration of the MRI and CT scanners in the operating rooms, surgeons will be able to more precisely guide their surgeries and advanced treatments. Their surgeries will become less invasive and more accurate with these new systems.

2.8.3. Interventional Imaging Suite

Adjacent to the Surgical Suite, the International Imaging Suite shall contain the latest imaging platforms that support all interventional diagnostic and treatment functions. Number of rooms shall be devoted to 3D neuroangiography; to vascular angiography; and to computed tomography scanning for biopsy procedures, as well as to guide ablation and injection procedures.

With state-of-the-art technological capability, the neuroangiography and interventional magnetic resonance imaging units shall form the core of the Stroke Center.

The Cardiac Interventional Rooms shall be located in the Interventional Floor also. Adult patients with coronary artery and vascular disease shall benefit from the latest angioplasties and plastic restorative surgical techniques. Children with congenital heart defects shall undergo minimally invasive procedures for correction of these malformations.

The placement of devices to close holes in the heart chambers no longer requires open-heart surgery. Both children and adults with such defects may have repairs done through a catheter system. To enable this type of cutting-edge approach, the Interventional Suite shall feature a state-of-the-art bi-plane real-time imaging with digital data capture and storage.

The Suite shall also feature a Stereotaxis on the application of magnetic catheter guidance devices. These devices use a large magnetic field to guide the catheter into very small vessels, where therapy can be delivered accurately and with a minimal amount of risk to the patient. The cardiologist shall be able to operate the catheter advancement system remotely, using an electronic "joystick" that advances the catheter into the appropriate location.

3. Outpatient Clinic

3.1. Medical Home Model

To accommodate this evolving collaborative care model, we must consider how to design flexible spaces for Team-based, Patient-driven programs that incorporate new technology.

The spaces in a medical home model are organized around the care team. Previously, nurses' stations were often remote from physician work/office areas. In this model, spaces are adjacent to each other, often to promote collaboration and shared information.

An individual exam room shall be designed to have fewer fixed elements to allow the rooms to easily accommodate different specialists and equipment. Group exam rooms in flexibly designed spaces will supplement private exams with educational programming and group support as preventive measures. Through this combination of individual and group exams, patients can better understand their conditions and learn how to control - and potentially prevent - problems.

Emerging technology continues to change the way patients approach healthcare and communicate with their care providers. Mobile devices, tablets, video conferencing and electronic medical records offer options for alternative approaches to traditional patient clinic visits. In addition to patient interaction, communicating via technology also expands the professional network by connecting physicians with specialists remotely – allowing for collaboration and care solutions.

Clinics today are already testing remote exams or consultations via videoconferencing or internet-based communication options, such as Skype. A patient can be with his or her primary care provider while video conferencing with specialists to discuss the diagnosis and care options.

Other evolving remote technologies enable patients to access their records online, conduct self-tests, and transmit data back to their caregiver.

In designing clinic spaces, we shall consider that some exam rooms may be replaced by consultation rooms with videoconferencing stations or computers equipped with a camera and microphone for internet-based video communication.

Just as technology is transforming the workplace, technology will continue to transform the clinic environment.

4. Translational Laboratory

The highly technological laboratory building within a healthcare community is a place for not only concentration but also communication.

The design shall emphasize maximum flexibility in its lab space, and provide space for staff interaction.

INNOVATIVE STRATEGIC PLANNING:

- Encourage Interdisciplinary Interaction
- Zone Building to Minimize Cost
- Office/Laboratory/Support Configuration
- Shared Support Space

Equipment Governs in the Future….

PLANNING CRITERIA

- Promote leading-edge research and education.
- Provide a flexible, collaborative environment.
- Provide an efficient, modular laboratory plan to enable the flexible assignment of research teams.
- Provide a "neighborhoods" of research offices, breakout spaces, and lab suites to create dynamic environments.
- Maximize access to daylight by arranging all laboratories and public spaces at the perimeter of the building, around courtyard or atrium.

In progressive research building, the design shall support the way modern science is conducted - collaboratively.

We shall strive to provide socialization areas, inviting laboratory and office spaces, and support spaces that are as flexible as the laboratories - all with a focus on underlying safety.

5. Conclusions

The primary concern shall be maximizing the desired social interaction and experiences of people who work in these facilities as we explore building aesthetics and function, and encourage collaborative discovery.

We shall ensure that the physical parameters of a building don't limit exploration.

Scientists expect the major breakthroughs of the next millennium to be facilitated by interdisciplinary collaboration. Translational research is driving designs that place research and clinical practice in close proximity to ensure a fast transference of knowledge.

The architecture shall respond to this thinking, creating learning environments that support scientific endeavor. Interdisciplinary facilities shall be designed so that no constraints are placed on intellectual curiosity. A flexible building allows new lines of exploration to be quickly pursued.

We shall pursue the 'meandering' areas between functionally defined spaces to create areas for contemplation and conversation which encourage the exchange of ideas to promote discovery and breakthrough.

We shall design buildings that enrich the lives of the people who use them – building that gracefully fulfill functional and technical expectations, yet appeal as fully to the senses as to the intellect.