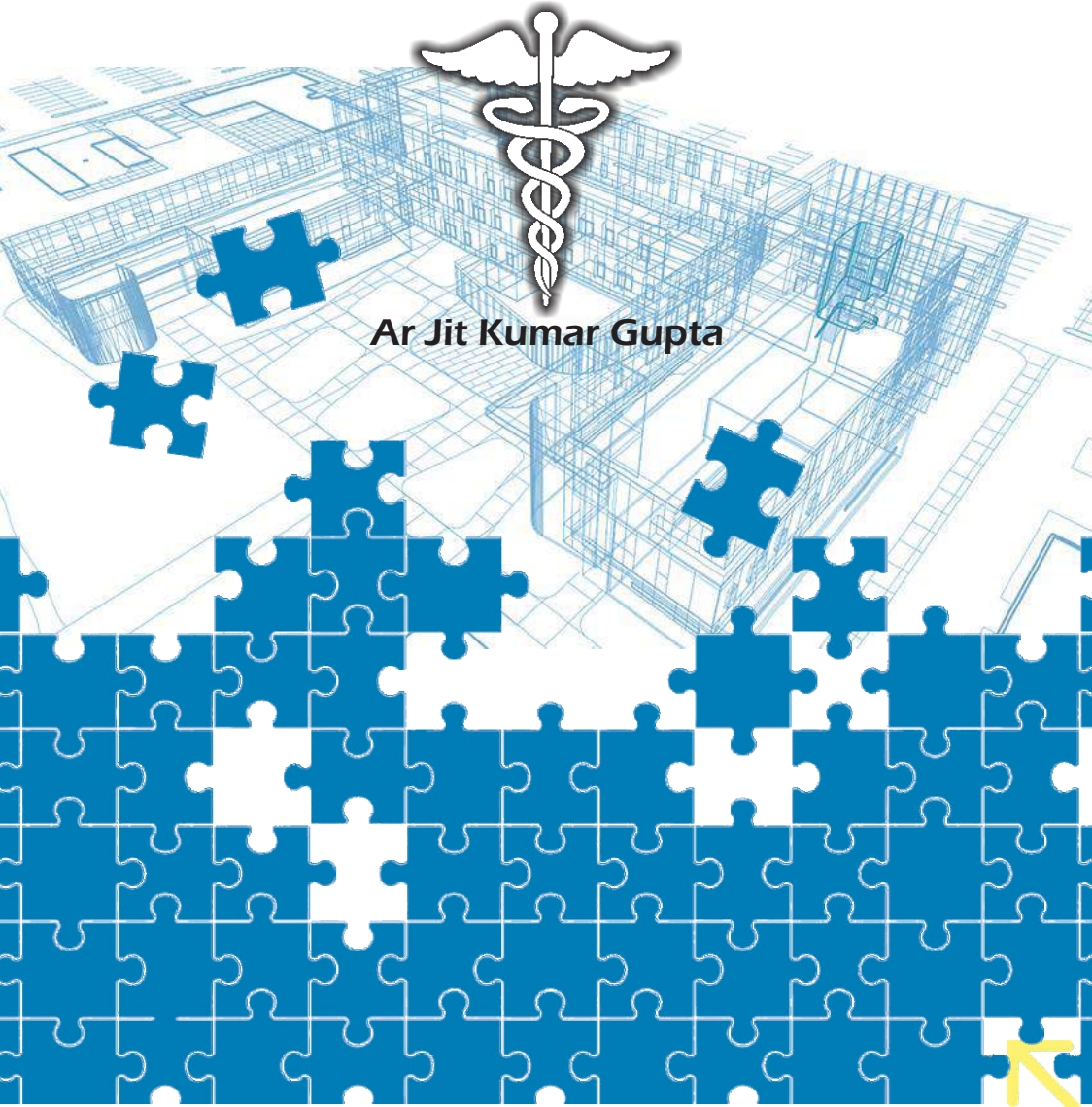
PLANNING AND DESIGNING FOR STATE OF ART HEALTHCARE FACILITIES

Brief Overview And Suggested Framework



Ar Jit Kumar Gupta

Planning and Designing For State of the Art Healthcare Facilities

Brief Overview and Suggested Framework

Ar.Jit Kumar Gupta
Former Director, College of Architecture,
IET Bhaddal, Punjab , India

Email: jit.kumar1944@gmail.com

FOREWORD

Healthcare remains one of the most critical sectors for promoting the prosperity and the productivity of any community, state and nation. All nations have on their agenda, to create state of the art health facilities in order to ensure that they have healthy and strong communities. However, existing healthcare system has been found to be lacking in capacity to effectively deal with issues arising out of infections. It remains vulnerable in the face of pandemics which are fast appearing on this planet from time to time. Appropriate infection control mechanism needs to be created not only in the building design but also in the building support system, more so to take care of vulnerable patients under quarantine. Covid 19 has clearly exposed the weakness of existing healthcare systems, both locally and globally. Looking objectively, existing health care systems face numerous challenges and problems. Sky-rocketing price of healthcare, a larger aging population, and discrepancy in the quality of healthcare constitute just a fraction of the problems within our healthcare system.

It calls for making our health care system more effective, efficient, environment and eco-friendly to deal with any unforeseen crisis. Accordingly, there is an urgent need of looking at prevailing practices of planning and designing of healthcare facilities, understanding limitations and problems faced by the system and bringing out new technological options to make the built environment to be healthy, hygienic and promoter of quality of life. I am glad that Ar Jit Kumar Gupta has brought out a book on, "Planning and Designing of the State of the Art Healthcare Facilities- Brief Overview and Suggested Framework," at this crucial junction , when health care facilities are under a lot of stress and strain. The book tries to bring out the context, issues and options for designing the quality healthcare facilities.

I am glad to see that sensitive space design for out-patient department, wards, operation theatre, critical care etc. has been dealt in detail from the point of view of hospital hygiene, needs of and infection control. I am glad that book proposes the planning, designing, construction and maintenance of all healthcare facilities should be mandated to be green to make them part of sustainable built environment. I complement Ar Jit Kumar Gupta, Chairman, Chandigarh Chapter of Indian Green Building Council, CII, for taking the initiative to make value addition to the healthcare facilities by bringing out this small but compact document. It is gratifying that book recognizes the IGBC rating system for the healthcare facilities.

V Suresh
Chairman, Indian Green Building Council, CII
Vice- Chairman, National Building Code
Former CMD, HUDCO

PREFACE

Healthcare facilities play a critical role in promoting health and hygiene of a nation besides responding to various emergencies including the present pandemic, epidemics, mass casualties etc. This document tries to provide way forward and basic principles, approaches and essential information about how the healthcare facilities need to be planned and designed to take care of healthcare challenges faced by any community at local and national level and how these facilities can fulfill their mandated role in making a nation healthy.

Target users for this brief write up would be hospital management and staff who are vested with the responsibility for establishing and maintaining the preparedness of hospitals. However, information would be relevant to the public, private, non-government, governments, para-statal agencies, health authorities, financial institutions, disaster management organizations and local suppliers which support and contribute to the hospital planning, designing, construction, operation and management through policy guidance or otherwise.

In this document, the term hospital has been used in the broader sense to denote any healthcare facility. Document tries to focus on the issues that hospitals need to be planned and designed for inbuilt flexibility to take care and be able to adapt to the specific challenges posed by any epidemic such as COVID 19, whatever the nature of the disease and the resources needed in the event of a concurrent emergency impacting large number of people. Needless to say, appropriate strategies for coping with epidemics should be made integral and essential part of the overall community and healthcare sector response with capacity to cope with epidemics including measures to protect staff, patients and visitors from infection.

An humble attempt has been made to study the astute thoughts behind planning and designing of health care facilities in the developed world, especially USA as these nations are found to be maximizing the use of technology by integrating innovative ideation along with modern technology into their designs.

Hospital buildings, with their high standards of hygiene and efficiency, are a restrictive brief for from a limited palette of materials. Would you let the interior requirements of the building define the exterior form is a question often raised by the design team. As a thumb rule, the lower floors generally contain surgical suites, research laboratories, dining facilities and maintenance areas. Future developments in medical technology may require spaces to be changed dramatically, while on the other hand, the role of a hospital (accommodating and caring for patients) is unlikely to change, are some of the key exigent factors that architects need to bear in mind.

As technologies advance, so should the ways they are used in healthcare facilities. For example, digital kiosks streamline the patient check-in process, while

advances in telemedicine improve the level of care that patients receive. To maximize the use of the latest technology, focus should be on these healthcare interior design trends.

Digital Kiosks with touchscreen monitors allow patients to easily check-in when they arrive at the facility. Patients are provided with wait-time information and digital forms.

Covid-19 has been responsible for postponement of elective surgeries and consultations not only in India but also worldwide. In spite of more than half of all hospitals in the United States use technology to provide healthcare remotely, the American Telemedicine Association has urged the US Govt to take further concrete steps to make Hospitals more accessible. India too, in the very near future, has to tread this corridor to address the healthcare needs of a vast population that reside in the hinterlands. These facilities often offer doctor-to-patient and doctor-to-doctor video consultations; patient health monitoring equipment, such as remote cardiac monitors; and 'wireless pill bottles' that remind patients to take their medications on time. Designing conference and exam rooms with large video monitors and desktop and/or mobile computers fit with webcams allow consultations regardless of location.

Virtual reality (VR) has greatly improved how we collaborate with clients. VR makes it possible to create a digital 3D model of any healthcare facility. This technology helps us and our clients make more informed decisions about a building's design. For example, you can see whether wall handrails are placed in convenient locations as you “walk” through a 3D model of each floor of your facility.

While Wheeled workstations allow doctors, nurses, and technicians to move from room to room and access patient information and other important data as they go, providing access to charging stations throughout your facility will allow patients, visitors, and staff to charge tablets and other mobile devices. These advances in technology improves operational workflow and staff efficiency, offer patients more options for care, and help the management decide which design details matter most in their facility.

Healthcare facility designers recognize the benefits of flexible, multi-purpose spaces. From featuring wheeled partitions in emergency departments to creating shell spaces in medical office buildings, architects help healthcare administrators treat more patients and maximize square footage. While designing adaptable spaces, trends like Pre-fabricated Partitions, Shell Spaces, Centralised Workstations and Modular Rail storage systems may be considered.

A prefabricated wall takes less time to install than a traditional wall and offers

flexibility. Breaking the walls down to adapt to new patient or staff needs or future renovations is simple. This is especially useful in emergency rooms, as you can change the size of treatment rooms or offer additional privacy to patients in seconds.

Shell spaces, or soft spaces, are areas that aren't vital to the daily operations of a facility, but serve as temporary placeholders for future expansion. When you design a few shell spaces that can quickly be converted into hard spaces, you make your facility more adaptable to accommodate additional patients and medical equipment.

Nurses often experience a great deal of stress and constantly seek more efficient ways to collaborate and care for patients. Centralized workstations provide them with the environment they need to succeed. Whether in a hospital or professional medical building, the workstation is the heart of nurse operations. By placing the stations in central locations, you can improve workflow and nurses can be in closer proximity to patient rooms. Fitting those stations with consultation areas allow nurses to collaborate with one another and discuss patient care with doctors and technicians. Centralized stations can also eliminate feelings of isolation and improve mood.

Wall-mounted rail storage systems are easy to install, flexible, and hold all sorts of items. If a space is currently an office, you can store office supplies inside for easy access. If you need to convert that space into a patient exam room, simply switch the storage bins for glove dispensers and bins that better accommodate materials physicians need during exams, such as antiseptics, gauze, syringes, and pen-lights.

By focusing on these healthcare interior design trends, you can maximize space for exam areas, nursing stations, or administrative tasks easily, allowing you to improve efficiency, patient treatment, and adapt to the growing needs of your staff.

Today, hospital designers focus not only creating beautiful spaces but also on using materials in those areas that protect against the spread of infection. Anti-microbial coatings as finishes on hoard surfaces and blue-violet spectrumlighting that fights the spread of a disease are the need of the hour.

Copper finishes are naturally antimicrobial and specifically used to kill E. coli, certain strains of Methicillin-resistant Staphylococcus aureus (MRSA), the influenza A virus, adenovirus, and other infective agents. Moreover, copper coating is aesthetically pleasing. For example, copper door handles used to help prevent the spread of infection are not only attractive but also add richness and warmth to the space.

Glass, ceramic, and steel surfaces coated in photo-active pigments kill microbes when they are exposed to artificial or natural UV rays. These coatings are often found on commercial and residential bathroom tiles to help them stay clean longer.

Installing indigo LED lighting can help kill bacteria. When bacteria absorb the light emitted by indigo LED bulbs, a chemical reaction is caused, which destroys the microbe's cells and limits the spread of airborne bacteria in treatment and operating rooms. These infection-control features if incorporated, can help improve the safety of patients, visitors, and staff. A biophilic interior design as illustrated in detail in this document, brings the outdoors inside. In a hospital, biophilic design most often connects communal spaces like atriums, entrances, waiting rooms and cafeterias with daylight and nature to promote a calming environment for all who enter. To implement biophilic design in your hospital, start by inviting more natural light into the space. Floor-to-ceiling windows, glass curtain walls, and skylights reduce the need for artificial lighting and help improve patient and staff moods. Additionally, a recent study published in the research journal Microbiome found that daylight exposure can serve as a natural disinfectant, specifically helping to kill bacteria commonly found in dust.

While biophilic design can successfully blend form and function and is perfect for non-sterile spaces, such as communal plazas, care must be taken when implementing it in other areas of a facility. For example, patient rooms should get ample natural light, but window design must not violate a patient's privacy. It's also not always feasible to have vegetation in certain areas of a health facility. In those cases, nature can be accessed through artwork and even earth-colored tones on finishes, walls, and floors. By targeting these objectives, one can create a cutting-edge facility, that fully supports the needs of patients and staff.

It is hoped that this document will be useful for planning and development of state of art healthcare institutions across the country. It is also hoped that students of architecture who are thinking of taking designing of healthcare facilities as a part of their final year thesis will make use of it. Document, however, remains incomplete and needs addition and alterations for making it more focused and comprehensive.

Ar Jit Kumar Gupta

Chandigarh

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01. CONTEXT

Healthcare becoming major priorities for nations to keep them healthy, happy and productive.

- ☑ Healthcare and economical development are known be positively related.
- ☑ Positive relationship exists between healthcare and productivity
- ☑ Globally spending on healthcare increasing rapidly on yearly basis - Higher the development –higher becomes the spending
- ☑ Healthcare spaces known for dualities and contradictions- spaces of hope, life ,care, cure, death and disease etc
- ☑ Healthcare– as a sector remains integral part of human living, development, growth and decay
- ☑ Healthcare sector reamains largely plagued by HAI (Hospital Acquired Infections) Syndrome
- ☑ Growing population/ longevity of life posing major challenges to providers of quality Healthcare
- ☑ Healthcare spaces in developing nations suffering from inadequacies /mismanagement /overcrowding-patients /visitors- both in quality as well as in quantity
- ☑ Healthcare sector - suffering from disintegration - both horizontal and vertical
- ☑ Healthcare sector known for creating large number of stresses and strains for both users and stakeholders
- ☑ Healthcare spaces generally dreaded by majority of users –known to be most inhospitable spaces to visit and treated.
- ☑ Large scale commercialization and entry of corporate sector in healthcare sector has brought in numerous unethical malpractices
- ☑ Healthcare sector suffers from – lack of respect and dedication for

University Hospitals, Cleveland, Ohio, USA

patients/ visitors/ families

- ☑ Patients treated generally as commodity and object of business rather than needing support, compassion and care.
- ☑ Mixing of patients/ visitors-- both indoor/ outdoor(privacy)-- remains a major issue and challenge in healthcare spaces
- ☑ Healthcare system has little faith in reducing cost/time and providing quality services- management/doctors
- ☑ Healthcare consumes lot of productive time of doctor/staff/patients for unnecessary travelling during the course of treatment on day to day basis and the problem gets compounded in large hospitals spread over large area. Limited work- travel studies has been made in the healthcare to promote operational efficiency.
- ☑ Healthcare sector known for duplication/multiplication of processes/procedures
- ☑ Healthcare suffers from the large disconnect between the treatment provided and services required
- ☑ Healthcare in majority of developing nations- suffers from lack of well defined systems/ standardization/quality manpower/quality medicine/quality management/ authentic documentation of patient care/treatment of diseases
- ☑ Healthcare sector suffers from subjectivity. It is largely driven more by whims and fancies of the attending/treating doctor and staff.
- ☑ In majority of cases- particularly in developing nations where healthcare lacks transparency in the absence of well defined procedures, systems of healthcare, treatment and diagnosis etc
- ☑ Architectural Design brief rarely prepared professionally- leading to emergence of large gaps between vision and reality in design and

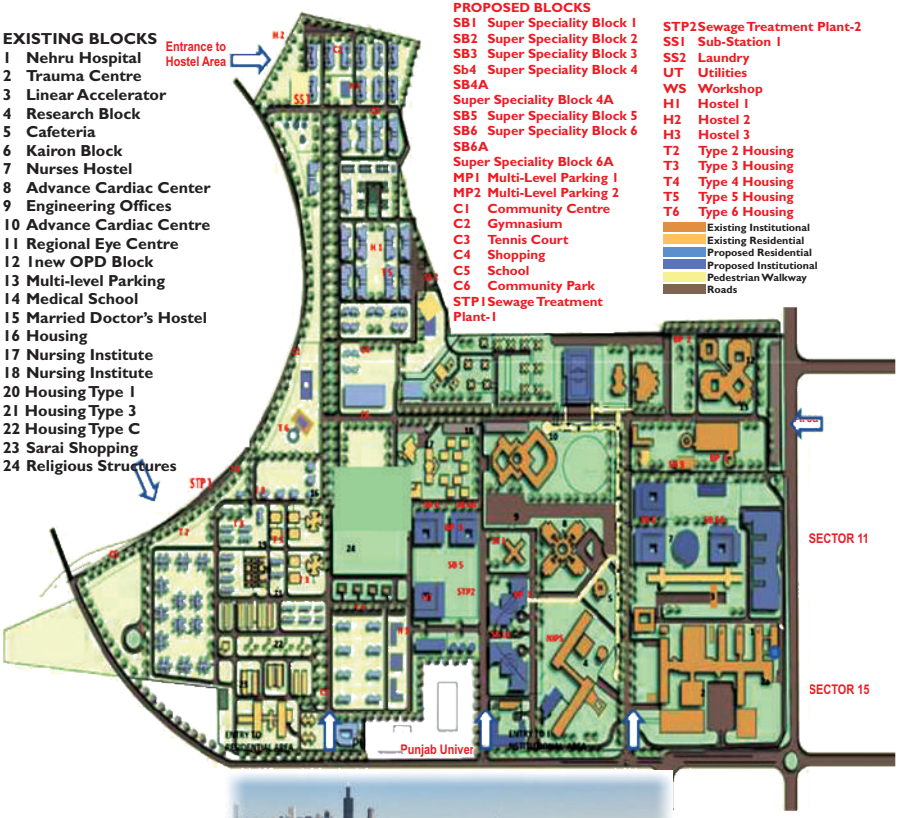
Seidman Cancer Center, 11100 Euclid Ave, Cleveland, Ohio, USA

operations of healthcare institutions.

- ☑ Healthcare design generally based on individual approach- not team based approach leading to mismatch between the perceived reality and virtual reality
- ☑ Majority of healthcare buildings not rationally designed spaces leading to their operational inefficiencies, cost intensiveness, causing stress both for doctors and patients besides making healthcare expensive and time consuming
- ☑ Majority of designers have little knowledge/experience and understanding of the complexity of operations of healthcare systems and institutions leading to creating institutions which are not able to perform and deliver.
- ☑ Most healthcare spaces designed without much research/ understanding and consultation with users and other stakeholders
- ☑ In the absence of dedicated course in the area of planning, designing, operation, management and provision of healthcare services, hospital design remains most ignored subject compared to its role and importance for individuals, communities, states and nations.
- ☑ Due to lack of knowledge and understanding of the operational and functional domain, healthcare spaces are being designed merely as built spaces – not as spaces for healing, care ,love , affection, stress busters, support etc
- ☑ Hospital Design has the power to positively affect multiple populations within a hospital.
- ☑ Healthcare projects generally suffer from cost-overrun and time-overrun
- ☑ With privatization and numerous options being available, there has never been a greater priority placed on ensuring hospital design results in a safe, clean, and peaceful healing environment.

Henry Mayo Newhall Hospital, Santa Clara, California, USA

Master Plan of Post- Graduate Institute of Medical Education and Research, Sector-12, Chandigarh- a pioneer institution in providing quality healthcare in the Northern India. Designed on the analogy of a self-contained institution- Campus includes both Hospital, Research, Diagnostics, Education, residential component for both medical, paramedical staff.

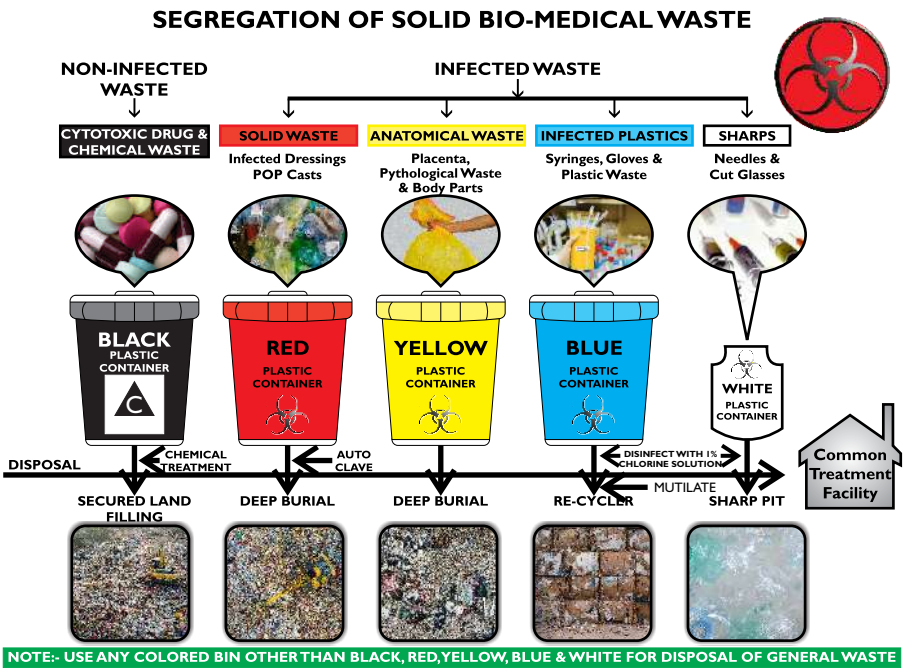


Rush University Medical Center, Chicago, USA

02. ISSUES

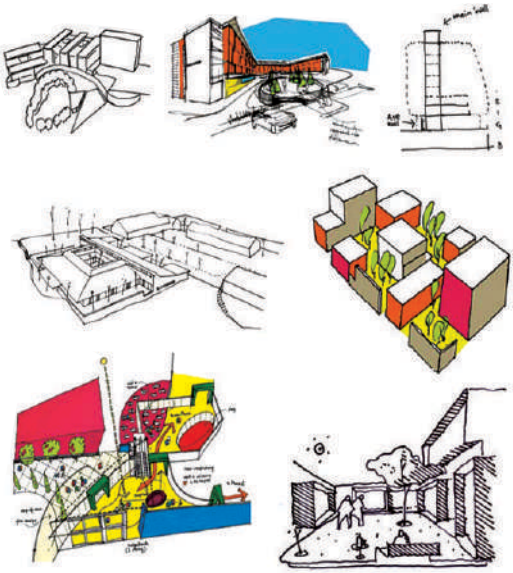
Major issues facing the healthcare institutions have been recognized in terms of patient care, quality of services provided, cost involved in healthcare, environmental issues, planning, designing and management of hospitals, safety, security, visibility etc. which inter-alia include;

- ☑ Healthcare institutions remain most cost intensive- unaffordable for majority of user
- ☑ Quality of services offered- vary to a large extent and remains an issue
- ☑ Time Intensive/time inefficient-In the absence of patient care support at home-healthcare always involve lot of time for patient / family/ doctors- with major time used in healthcare in non-medical procedure
- ☑ Quality of services rendered /treatment --remains a major issue Healthcare remain largely spaces of stressful refuge
- ☑ Health care remains a labor-intensive industry- highly skilled/ highly paid; Accounting for 60 to 75% of hospital expenses
- ☑ Healthcare cost calculated on short term basis rather than long term-- life-cycle cost
- ☑ Healthcare institutions remains unsustainable- being large consumer of resources – energy, water, chemicals etc
- ☑ Healthcare institutions -- large generators of waste,
- ☑ Healthcare institutions- responsible for large carbon footprints
- ☑ Healthcare spaces generally remain --dirty/filthy – poor waste management
- ☑ Healthcare spaces -Storehouse of major infections
- ☑ Healthcare spaces—generally un-friendly to professional patient management
- ☑ Consumer decisions to choose healthcare facilities based on---- cost/ accessibility/ quality
- ☑ Healthcare call for--Ever changing demand of service/ quality of medical care/ post-care treatment/ pleasing facilities for new technologies/services
- ☑ Healthcare demands--High degree of inbuilt and operational flexibility for dealing effectively and efficiently with Disasters- manmade/natural
- ☑ Healthcare largely suffers from--Absence of quality literature on designing

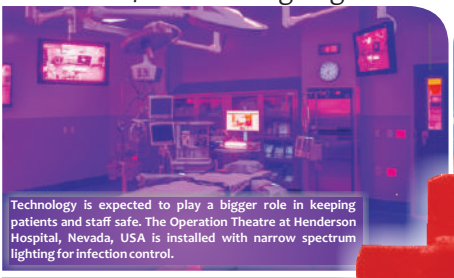


healthcare related spaces

- ☑ Limitation in design imposed by--Rigidity of Local bye-laws and Zoning Regulations due to poor/lack of recognition of the special needs of healthcare buildings
- ☑ Healthcare designing suffers from--Lack of Standardization
- ☑ Delayed projects- involving cost-overrun/time over-run
- ☑ Inefficient utilization of built spaces with large proportion of total built space going under circulation
- ☑ Large dependence on conventional source of energy



- ☑ Poor Waste management within and outside healthcare institutions
- ☑ Problem related to Parking of vehicles
- ☑ Problem of Way-finding for both patients and visitors causing lot of inconvenience
- ☑ Injury/ problems suffered during-- Shifting/movement of patients- both horizontal and vertical
- ☑ Mixing of indoor with outdoor patients- public and patients
- ☑ Management of Visitors
- ☑ Quality Patient Management
- ☑ Managing and maintaining public utilities /toilets/public services etc
- ☑ Too much involvement of families in managing patients
- ☑ Designing / Positioning of patient wards/operational theatres/doctors/ nursing stations
- ☑ Managing patient related services – gasses/equipment etc
- ☑ Sending samples to labs and sourcing test reports
- ☑ Procuring medicines by patients
- ☑ Absence of quality eating spaces
- ☑ Inefficient use of spaces
- ☑ Doctors/staff wasting large time in travelling during patient treatment



Technology is expected to play a bigger role in keeping patients and staff safe. The Operation Theatre at Henderson Hospital, Nevada, USA is installed with narrow spectrum lighting for infection control.

Infra Red Imaging Technology now installed at many airports for Thermal Imaging can also be deployed by hospitals where footfalls of patients, their relatives and OPD visitors are high for better contact-less mass screening at entry points.

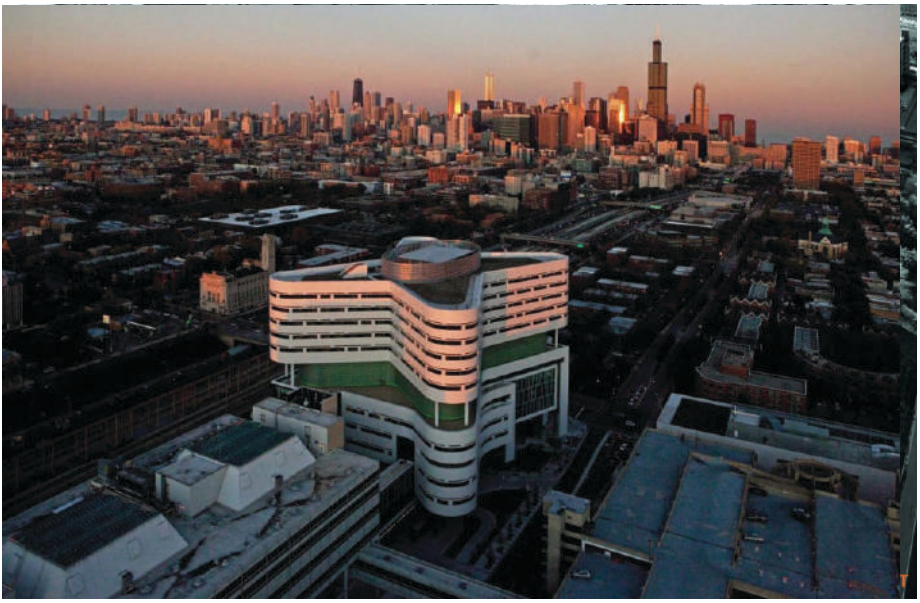
Planners must ensure ample parking spaces are reserved for disabled and for vehicles driven by differently abled visitors.

Improper designing of parking lot is the root cause of creating conflict points and increment in noise levels.

03. OBJECTIVES

Objectives defined to be achieved through rational Architectural Planning and designing of all healthcare institutions should invariably include:

- ☑ Creating dynamic, ever- evolving, devolving and innovative, healthy , pleasant, safe and sustainable patient centric built environment,
- ☑ Creating a patient-centric healing environment serving the needs of the growing community;
- ☑ Integrating family into the patient experience,
- ☑ Creating a work environment that support and empower patient and staff with designing based on the principles of evidence-based design



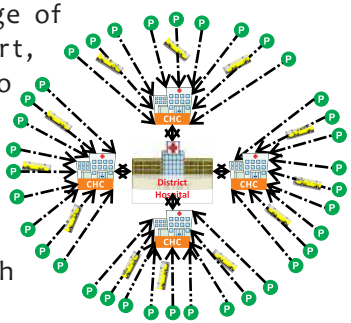
Sustainability Features - Tower Rush University Medical Center, Chicago, USA

04. DESIGN APPROACH

A hospital is not an industrial space/ office space/ a hotel- accordingly needs to be designed differently with care, caution, dedication and commitment based on detailed study and in-depth analysis --to create spaces which are supportive to both users /operators. Both patients/ doctors need to feel comfortable--having a pleasant environment.

- ☑ Healthcare sector involves number of building typologies: varying in scale, size, operations, intent, contents and manpower -- Ranging from small/simple medical clinics to large/complex/costly, teaching research hospitals- having their distinct space/patient/staff /operational requirements
- ☑ Healthcare architecture can be very complicated, particularly when it comes to extracting a brief describing the requirements that need to be accommodated into the buildings.
- ☑ Architectural Design remain critical and has major implications in terms of; providing state of art healthcare; improving quality of patient care; empowering staff/patients; increasing operational productivity /efficiency reducing staffing needs and improving bottom line of institution.
- ☑ While preparing Architectural Design for healthcare institutions, architects can think of keeping following points in view:
- ☑ Adopting Team Based Approach: Healthcare institution design shall always be a team based outcome with team having understanding of the value the project needed to deliver in terms of :
  - → Enabling innovation to provide the best outcomes for patients;
  - → Promoting healing by incorporating natural light, colors, and art;
  - → Driving efficiencies by applying smart design/ simplifying work for staff;
  - → Ensuring safety of patients, staff, and all who enter the facility with

- → Ability to send a message of oming, caring, comfort, compassion, commitment to patient well-being and safety.



Proposed Approach:

Bring People to Strengthened CHCs / Health-care Hubs

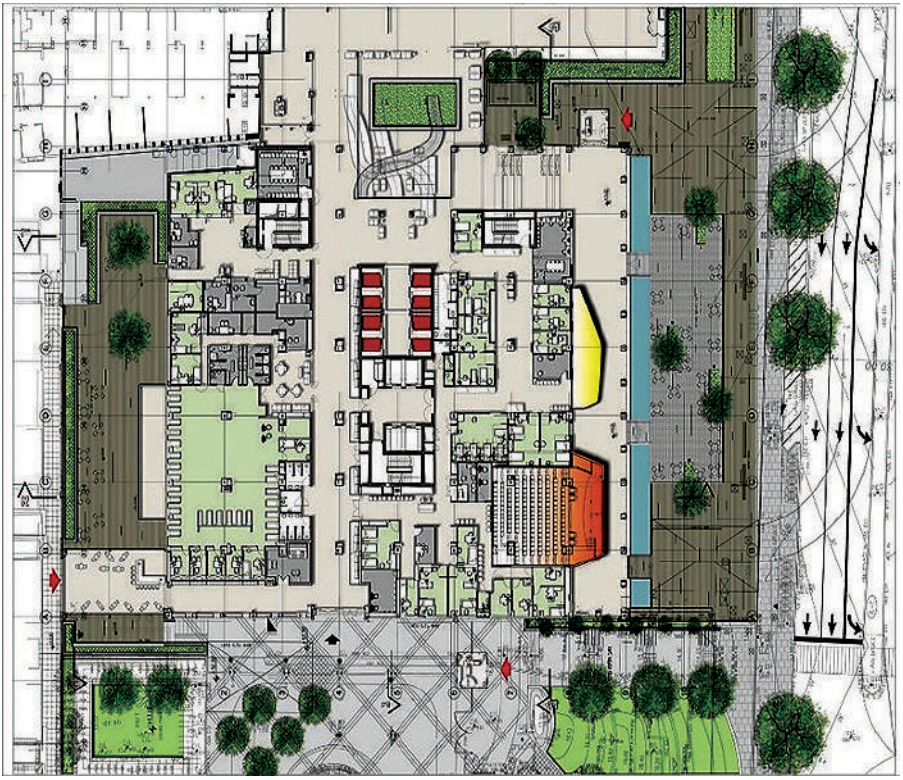
- Consolidate and strengthen selected CHCs, District Hospital & Sub-Division Hospital-Bari to serve as **'Healthcare Hubs'**
- Feed **'Healthcare Hubs'** through Healthcare-Vans to cover entire district

☑ Making hospitals: patient-care centric / Design for comfort/care

Approach to the designing heath care facilities shall revolve around;

☑ Providing quality/state of art healthcare s services at

- → Most affordable cost
- → Consuming minimum possible time
- → Causing minimum inconvenience to the patient and family



IGBC Green New Buildings	IGBC Green Existing Buildings	IGBC Green Homes
IGBC Green Residential Societies	IGBC Green Interiors	IGBC Green Healthcare
IGBC Green Schools	IGBC Green Factory Buildings	IGBC Green Data Center
IGBC Green Campus	IGBC Green Villages	IGBC Green Townships
IGBC Green Cities	IGBC Green Existing Cities	IGBC Green SEZs
IGBC Green Landscapes	IGBC Green Mass Rapid Transit System	IGBC Green Existing Mass Rapid Transit System
Government Incentives to IGBC Projects	IGBC Green Affordable Housing	IGBC Heath And Well-being Rating
IGBC Green Resort Rating		

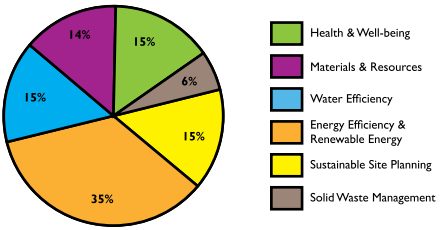
IGBC GREEN BUILDING RATING SYSTEMS

SOURCE: IGBC

- ☑ Designing Green Buildings: by using nature and natural elements/ resources- sun, air, daylight, site and water as part of the design strategy- reducing use of water/energy up to 50% and to minimizing infections.
- ☑ Designing Compact: to minimize the horizontal spread of buildings and to reduce footprints of buildings , reducing travel, minimizing service network
- ☑ Design Smart: by adopting Lean Design Principles
- ☑ Design Respecting Site: Designing with site, site conditions, existing physical features, levels, topography, flora & fauna etc
- ☑ Design with Climate: Climate considered in three contexts- Micro/Meso /Macro i.e. Site climate; City climate and Regional climate & Climate zone
- ☑ Designing with Orientation: Making optimum use of site orientation and air-flow to create passive design solutions depending on the nature of hospitals

- ☑ Designing with Consultation: Involving all stakeholders/users- Administration, Doctors, Staff, service providers, Patients, Users, Equipment suppliers to have best options of patient care/treatment

Figure 1 :Weighting of various criteria as per GRIHA

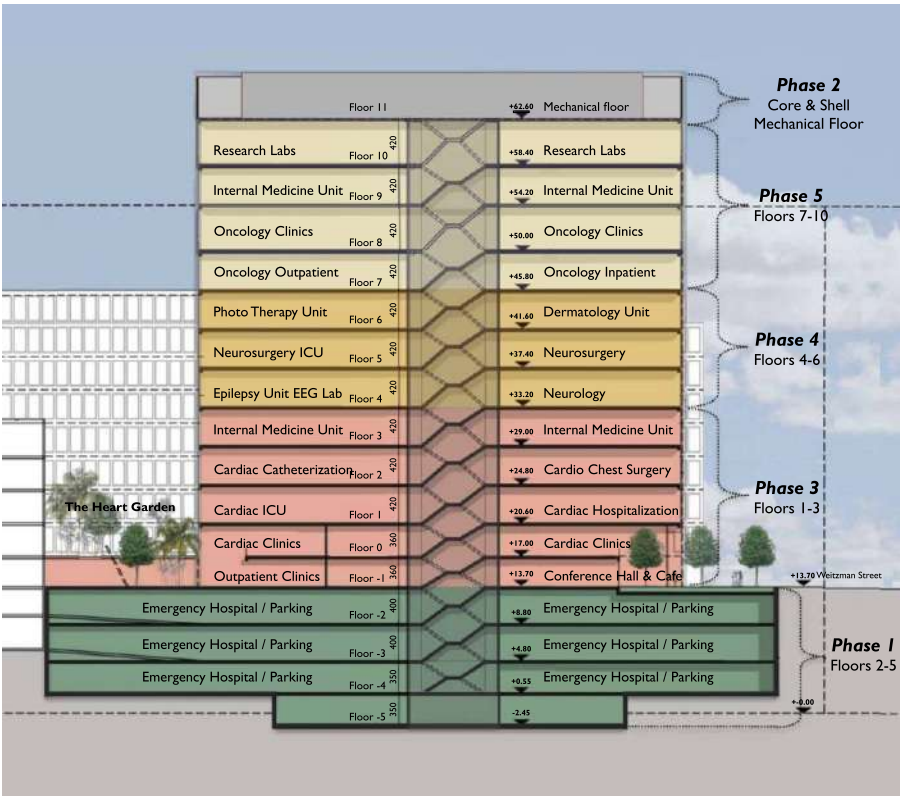


Source: Majumdar, M. (2008). TERI

- ☑ Design for Visibility: Visibility of patients to staff most important. Architecturally,19th century ruled-- form follows function, whereas in 21st century it is mandated- form shapes function. Making choice of a well-chosen form helps providers deliver services more efficiently/cheaply. Unit designs must allow caregivers to be visual in proximity to the patients under their care. Visibility can be enhanced through patient rooms designed in a mirrored manner.
- ☑ Designing for Simplification/ Standardization/Quality of procedures/ processes both medical as well as non-medical
- ☑ Designing for Integration: Healthcare staff typically accustomed to taking a more siloed approach to facility planning. Integration closes the gaps between many diverse areas of focus across the organization. Integration helps engage key stakeholders across the organization of all hospital activities/action- specialties /staff/operations for;

  → increasing efficiency,

Nehru Hospital, PGIMER Campus, Sector 12, Chandigarh



- → advancing quality of care,
- → improving satisfaction among patients and staff.
- → strengthening organization's brand
- → build greater value into every square foot of space,
- → transforming departmentalized points of view into holistic solution
- → deliver higher return on investment.

☑ Designing spaces for Multiplicity of uses- all spaces need to be planned and designed for putting to multiple uses for optimising

☑ Designing cost- effective buildings: project needs to be designed and constructed within minimum time span at minimum cost without compromising with the quality of buildings.

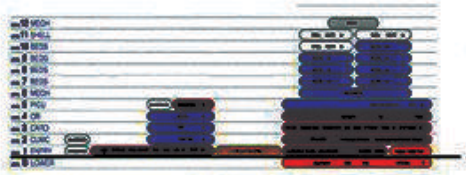
☑ Looking at Life Cycle Cost: Looking at the life-cycle cost and not the initial

stacking

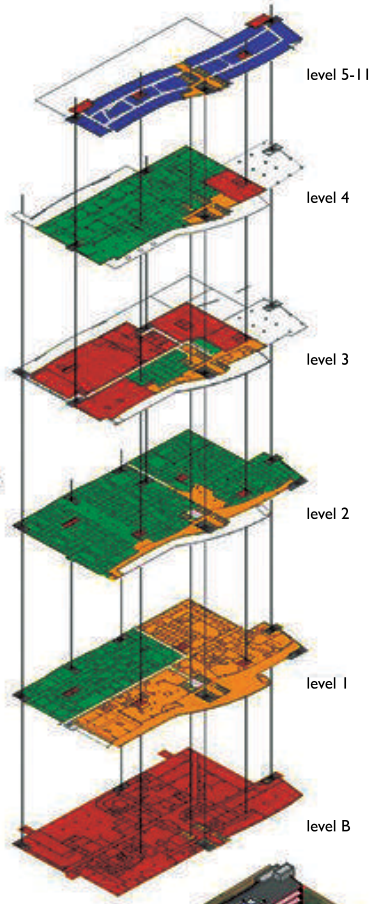
Functional Organization

The design team brought best practice ideas from recent pediatric projects from coast to coast and collaborated with existing and new medical, administrative and clinical staff to create efficient, innovative planning solutions with flexibility to adapt to various care model choices. Vertical stacking reduces horizontal travel for medical and support staff. The atrium links the main entrance with elevators, ancillary and public services and the day-lit path to the existing hospital. All public elevator lobbies provide views to the outside and directly connect patient families to clinical and public functions. Flexible pediatric clinics are grouped in expandable modular units to ebb and flow with daily need. Invasive sedated procedures are collocated for efficient prep and recovery service. Inpatient units are de-centrally staffed as intimate clusters but each floor accommodates 48 flexible beds with family, faculty and staff support areas.

Functions
- patient care units
- lease space
- public / administrative
- building services
- outpatient clinics
- diagnostic / treatment
- circulation
- vertical circulation / shafts
- auxiliary color



EXISTING HOSPITAL CONNECTOR PATIENT TOWER EXPANSION



patient care

Patient Safety
Medication Delivery
Access to toilet
Caregiver access
Toilet Room configuration
Visibility of Patient
Auditory Pathway
Standardization

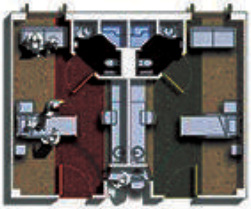
Staff Efficiency
Access to data
Access to supplies
Clearance at bed
Overall Travel Distance

Circulation
Access to patient head
Access around patient
Transport in/out of room

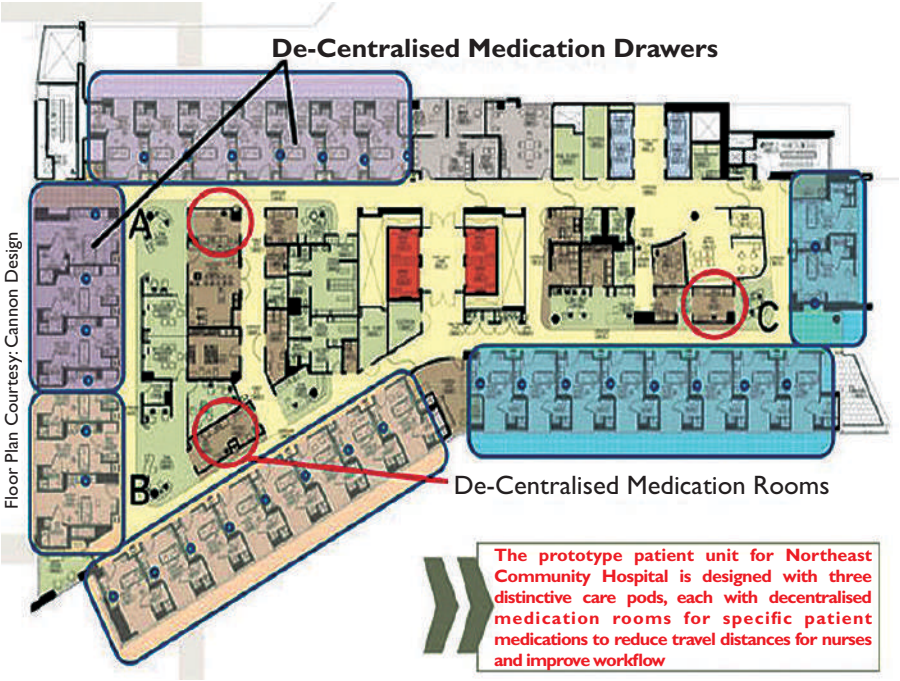
Patient Considerations
Privacy
Visibility from Public
View of Exterior
Day lighting
Patient Storage

Infection Control
Housekeeping Access
Handwash Location

Family Amenities / Space
Proximity to patient
View of TV
Sleeping Arrangements
Guest Seating

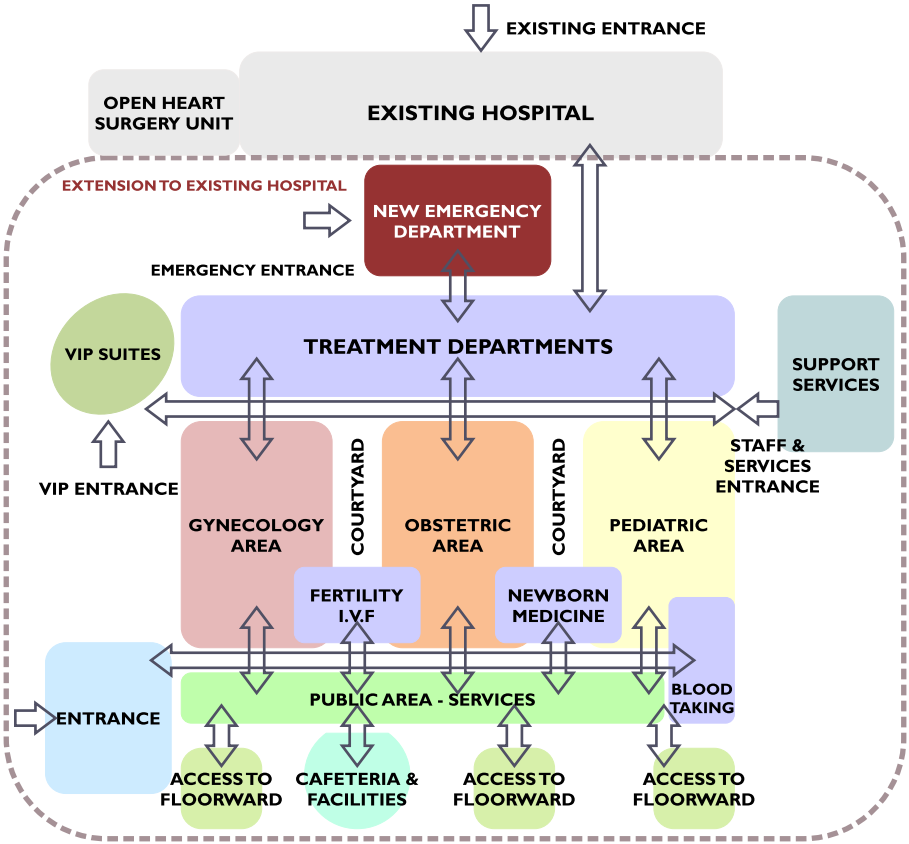


phoenix children's hospital



cost by minimizing both the principal cost & operational cost of buildings, which in turn helps in minimizing the healthcare cost to patient

- ☑ Promoting operational efficiency: Building designed to increase the operational productivity / efficiency of doctors / paramedical staff -- reducing staffing needs which leads to improving the bottom line
- ☑ Design for Accessibility not Mobility/Minimizing travel: of doctors / staff / patients to improve operational efficiency /productivity
- ☑ Empowering the doctors / para-medical staff: by making design supportive of their day to day operations to promote operational efficiency and delivery of quality patient care.
- ☑ Empowering the patients: Designing rationally patient related spaces to help enable patients march towards self-sufficiency.
- ☑ Design Bright: making optimum use of natural daylight in the habitable spaces.
- ☑ Design for Aesthetics /Design for visibility: creating a structure which is aesthetically pleasing to look at – both internally and externally.



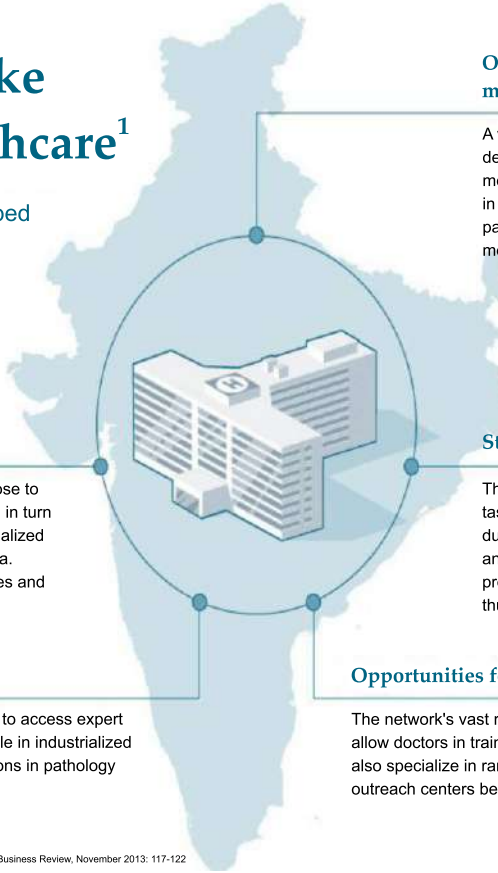
- ☑ Design with nature: for making optimum use of available natural environment - using existing flora and fauna, creating water bodies, promoting, forests, green spaces, creating green cover, planting more trees, creating good views etc.
- ☑ Design for Flexibility: Design for Disasters/Emergencies - Healthcare institutions required to a play major role during disasters - planning /designing must accommodate this aspect of community welfare.
- ☑ Design with Technology / Design for Future / Since medical science / procedures / processes / approaches are rapidly changing due to latest scientific innovations coupled with use of IT and other technologies: all healthcare institutions must be designed to have an inbuilt flexibility to accommodate new technologies without changing existing structures.

Technology to be a crucial component to improve patient safety; developing an information infrastructure to support healthcare delivery; eliminating manual and most handwritten data.

- ☑ Design for Controlling Infection - Fabric usage in hospitals is decreasing because Curtains are known to be promoter of contamination transmission. Translucent, double-faced or woven fabrics offer the high-quality answer for curtains in hospitals.
- ☑ Designing for Way-finding - When architecture, medical planning, interior designing and environmental graphics- harmoniously blend, a first-time visitor can walk through a space without the aid or "you are here" maps. Aligning the patient journey with key architecture and interior elements alleviates the need for excessive signages, which can become distracting. Less signages also means more room for design that creates joy and delight. For example, bold colors or visually display changes at elevator pull people toward them. Using the concourse concept or promenade to connect departments together is a way to intuitively organize way-finding. Signages / Finishes/artwork need careful selection / coordination / Integration for improved way-finding.
- ☑ Design for Minimization maintenance/ Design for Optimization - innovative designs facilitates reduction in maintenance and ensures optimization of available resources.

The Hub-and-Spoke Approach to Healthcare[1]

The model, which was primarily developed in rural India, is as affordable as it is effective - and could even serve as a model for industrialized countries.



One central hospital - many small outreach centers

A well-equipped hospital with specialized departments and doctors provides first-class medicine at an international level. Small clinics in rural areas serve as points of contact for patients who would otherwise be cut off from medical care.

Better channeling of patients

The network makes it possible to treat many patients close to their homes and prevent excessive journey times, which in turn lowers costs. At the same time, patients who need specialized treatment can be filtered out from a large catchment area. This increases the volume of patients in the main facilities and leads to better utilization of the equipment pool.

Structures that complement each other

The hub-and-spoke network aims to allocate task and focus resources instead of unnecessarily duplicating structures. Less specialized doctors and medical staff can make many diagnoses and provide routine treatment in the outreach centers, thus easing the burden on the hub.

Use of expertise

The hub-and-spoke model makes it easier to access expert knowledge from the periphery. One example in industrialized countries is expert telemedicine consultations in pathology and radiology.

Opportunities for training and specialization

The network's vast reach and the large number of patients allow doctors in training to gain broad experience and also specialize in rare diseases. For their part, staff at the outreach centers benefit from regular training programs.

Vijay Govindarajan, Ravi Ramamurti: Delivering World-Class Health Care, Affordably, Harvard Business Review, November 2013: 117-122

05. PROCEDURE FOR DESIGNING A HOSPITAL

Start with a clear Vision, Mission and Objectives: Start with a clear vision and mission for your project, defining guiding principles for the initiatives-objectives to be achieved, nature/ quality of services to be rendered and enumerating values to be added before planning a healthcare facility. Understanding clearly intended project purpose, identifying clearly overarching goals helps preventing later retrofit would remain critical for planning state of art healthcare facilities.

II. **Selecting and mapping an Appropriate Site:** Site remains critical for the success of any healthcare project. When selecting the location of a medical facility ; factors that need to be considered are:

→ Location- conformity to the Regional/City/Zonal/Local context

→ Shape and size- for optimum utilization of space

→ Area – sufficient to meet current and future needs

→ Cost of land- to be affordable

→ Accessibility- High from all the serving areas

→ Visibility- critical for the use and success of the institution

→ Potential for future expansion

→ Proximity to the population to be served with future growth- economical/social

→ Conformity to the Master Plan/Development Plan of area

→ Freedom from sources of pollution- air and water, polluting Industrial

→ Freedom from noise pollution - site not to fall below air funnel / abutting on the highway / a railway track / close to traffic nodes - bus terminals stand / railway junctions etc.

→ Closeness to service network -- electrical / water / sewerage / transportation etc.

→ Freedom from existing encumbrances - heritage / religious structures.

→ Getting the site physically surveyed - showing dimensions of sites, boundary, site angles, levels of site, contour study, physical features, existing trees / vegetation, city / local service network including water, sewer, sanitation, electrical, roads, tele-communication, gas etc; access roads to the site - dimensions / right of way / carriage way, road berms, pedestrian facility etc.

SITE PLANNING

III. **Creating a dedicated team of experts / participatory approach:**

Success of any healthcare project shall be contingent upon assembling and involving a team of experts, having appropriate knowledge, experience, expertise and understanding of planning and designing of healthcare institutions, right from the day of the conceptualization of the project. All participants must share a common focus and commitment to the design process. The team should comprise of experts from the domains of Clinical delivery, Technology, Regulatory compliance, Planning, designing, construction, public health services, electrical, mechanical, fire, safety, structure, landscaping, facilities, equipment supplier, finance, management, healthcare, green buildings, HVAC, human resources, medicine, surgery, art, maintenance, transport and media that:

→ brings together all aspects of healthcare operation

→ establishes clear governance

→ helps formulation a realistic project brief/building program and estimating funds for the project

→ ensures rational project spending and minimizing waste

→ eliminates duplication/overlapping

→ ensures completion of project without cost-overrun /time over-run for the project

→ avoids over-sizing/under-sizing of the systems/service

→ optimize /standardize medical operation/procedures/systems/ operations

IV. **Preparing a Project Brief:** Preparing a fine tuned project brief shall be critical for the successful planning, designing, construction, operation and management of the project. Project brief shall be prepared based on the collective wisdom of the team of experts which shall include scope of project; specialties to be provided; number of hospital beds to be provided; out- patient requirement; emergency services to be provided with capacity; diagnostic services to be deployed; Administrative requirements; Specialty wise-area, doctors, patients, equipment, waiting area details; Out-patient area details, general waiting areas, area and details of labs, area for canteens visitors and pantries for staff; area for parking, area for services, storage area, patient's record rooms, and total covered area for the project. While finalizing the space requirement norms and standards prescribed by the statutory and regulatory bodies, medical council, national building code, Time saver standards, fire standards, local bye-laws etc need to be consulted and incorporated.

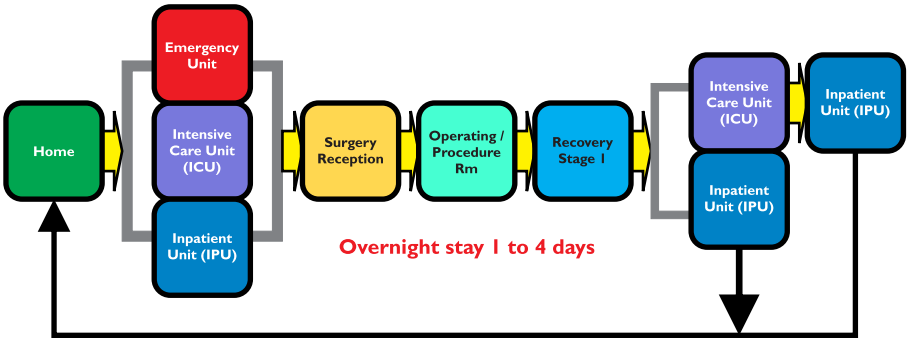
V. **Study and Evaluation of Zoning Regulations & Building By-laws:**

Before undertaking the design exercise, Architect engaged for the project, will have to understand and evaluate the Zoning Regulations and Building Bye-laws applicable to the site so that design prepared for the healthcare institution will meet all the statutory requirements of building proposals and shall receive timely approval of the Competent Authorities. In addition, it will help in assessing whether the project brief falls within the scope of permissible building regulations or needs a change. Study of the Zoning Regulations and Building Bye-laws shall involve; Looking at the permissible land use of the site selected as per the master plan/development plan/zonal plan; Zoning Regulations , Local Building Bye-laws to determine the permissible site

ZONING REGULATIONS

coverage at ground floor and higher floors; Total permissible coverage on plot; area to be included/excluded while counting the floor area ratio; setbacks on all sides; minimum distance to be provided between different buildings within the project site and between blocks of adjoining sites; maximum permissible height of building; plinth height; parking norms and standards; total number of Equivalent Car Spaces to be provided; fire safety provisions; provision related to basement / stilts-area and its usability; building projections, security regulations; permissible residential accommodation in building; minimum area under courtyards; minimum height of rooms; maximum number of floors permitted for building; area of the site to be kept as soft or open area; scale to which drawings to be prepared; number of drawings or sets to be submitted in terms of plan, elevations, sections, services, structural safety, fire safety, parking etc. for approval of building plans and the various fee and charges to be paid as part of the approval process.

VI. **Designing the workflow Chart:** Major maladies in designing hospitals occurs when Architects directly start with the design of physical components. The effect of this approach is often irreversible, causing staff to adjust their workflows in order to "make it work." Building a new facility provides a tremendous opportunity to re-evaluate and rationalize existing workflows to optimize the flow of patients, staff, equipment and materials. To achieve this objective, it will



Operation Theatre - Flow Diagram

be appropriate before architectural designing are worked out, to work with an improvement team for re-designing workflow processes to leverage lessons learnt from existing facilities and to stimulate new ideas for providing the best experience for patients, families, and staff.

VII. **Carryout Site Suitability Analysis / Use Zoning:** Before starting with the design exercise, Architect needs to carry-out a detailed and in-depth site suitability analysis to determine which are the areas of the site most appropriate for positioning the healthcare buildings, areas suitable for parking and area which should be used for landscaping, services and housing the staff deployed in the healthcare. The decision shall be based on the orientation of the site, entry and exit permitted, prevailing wind direction, availability of service network, levels of the site, number of users, visitors, patients, paramedical staff, amount of traffic flow from the city, existing flora and fauna, construction in the vicinity of site, shape and size of site, urban design concept, setbacks, statutory limitations, height permitted, soil bearing capacity, water table, access roads to the site etc. Preferably all low lying areas in the site should be used for landscaping or parking/creating a basement under the buildings. Emergency areas should command visibility and direct access from roads leading to site/institution. Parking areas should be closely linked with patient areas. Out-patient areas must be clearly segregated from the in-patient areas. To the extent possible, diagnostic and lab areas must be centralized and connected with all different sections of healthcare. Effort must be made to promote sharing of spaces and services to minimize the inconvenience caused due to movement of patients and staff.

SITE SUITABILITY

Healthcare Facilities with Biophilic Design

Khoo Teck Puat Hospital and the Jurong Health Campus of Ng Teng Fong General Hospital and Jurong Community Hospital are premised on the idea that designing an environment which connects people to nature can enhance their health and well-being. With biophilic design, the hospitals enable direct contact with nature, have materials and colors representative of nature, as well as spacial features characteristics of the natural environment.

	Khoo Teck Puat Hospital	Ng Teng Fong General Hospital and Jurong Community Hospital
Opened in	June 2010	June 2015
Capacity	690 beds	700 beds NTFGH and 400 beds JCH
Cost	$700 million	$1 billion
Green Area	10,197 sq. m.	22,000 sq. m.
Energy Savings	33% less energy used than in conventional hospitals.	• 30% less energy used than in conventional hospitals. • More than $5 million savings in electricity bills annually (enough to supply 4,448 HDB 5 room flats for 1 year). • Nearly $1,00,000 in water savings annually (enough to fill 27 Olympic-sized swimming pools).

The 953 sq. m. Jurong Health Mobility Park is an outdoor rehabilitative space which simulates real-life street environments such as pedestrian crossings, walkways with different surfaces, ramps, steps and roadside curbs. The park also includes a sensory garden with herbs and plants - at the height of wheelchair users - to heighten patients' sense of touch, feel and smell.

A waterfall in the central garden courtyard of Khoo Teck Puat Hospital

Planter boxes outside the wards in Khoo Teck Puat Hospital

Planters outside the wards at Jurong Community Hospital

A bird on a bird-fishing porch in Yeshun Pond, adjacent to Khoo Teck Puat Hospital

The healing garden that links the Ng Teng Fong General Hospital Intensive Care/High Dependency Unit with Jurong Community Hospital. Stabilised ICU patients can be wheeled out to enjoy fresh air and greenery.

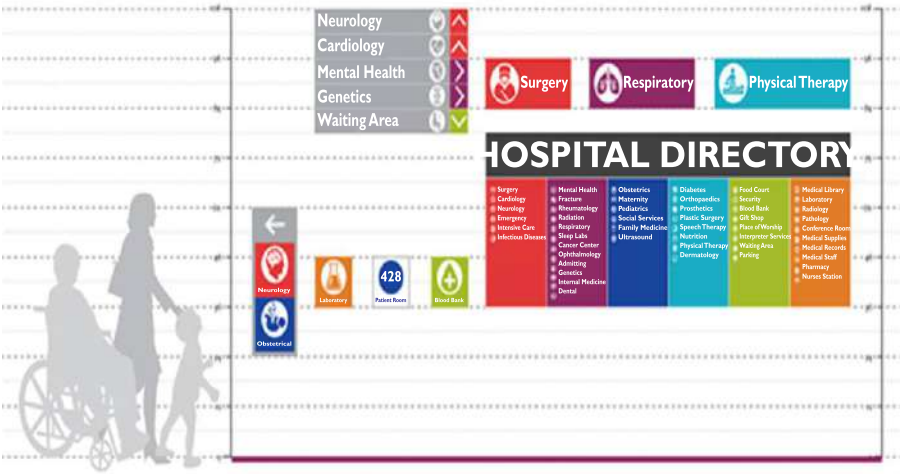
Based on the site suitability analysis, conceptual master plan of the healthcare institutions should be drawn for setting the framework for designing of built-form.

VIII. **Design for Sustainability:** Sustainability must be a consideration for the design of all health care facilities. Many sustainable design features can be incorporated into health care facility design, including day lighting, energy and water conservation, non-toxic materials and finishes, and sustainable operations and maintenance. Health care facility must meet the specified and prescribed energy and water conservation standards for sustainability. For promoting sustainability, rain water harvesting and sourcing solar energy must be made an integral part of the design. In addition, efforts need to be made to reduce, recycle and reuse all the waste which is generated on a day to day basis. Instead of adopting a linear approach, circular option will be best for treating waste.

DESIGN FOR SUSTAINABILITY

IX **Design with Nature:** Connecting with nature through the use of windows and natural day light helps patients in their rehabilitation efforts. Research has shown that view of nature helps reduce stress and patients

Top Left: Privacy is the key in this design at Mercy Health Anderson, Cincinnati, OHIO, USA
Top Right: Ample sunshine beams into this room at Mercy Health Anderson, Cincinnati, OHIO, USA
Bottom Left: Reception at Cleveland Clinic, Ohio, USA
Bottom Right: Efficient Nursing Station at Banner Boswel Medical Center, Sun City, Arizona, USA



with less stress feel less pain and don't need as much pain relieving medication.

X. **Design for Comfort and Care:** Carefully designed spaces within a healthcare facility can influence patient healing rates, decrease the length of hospital stays, and even impact something as basic as a good night's sleep.

XI. **Design for Privacy:** The best designs have a clear divide between "front of house" and "back of house" or "onstage" versus "offstage." Patients and visitors are more comfortable if they are not exposed to the full operational plant of a hospital.

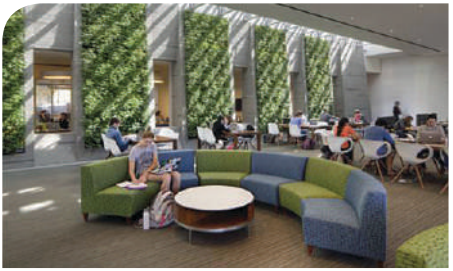
XII. **Design for Simplicity with Way-finding:** Way finding is a challenge in all hospitals. Keep any design simple and limit the amount of decision points for patients and visitors. Way-finding is by no means restricted to reception staff and porters – medical doctors and specialists play an essential component in hospital architecture design too.

XIII. **Design for Safety:** The greatest risk for patients during a hospital stay is

Flexible Wall Piping of Medical Gas. Courtesy: Detroit Medical Center, Michigan, USA

hospital-acquired infections, medical errors and falls. This is where a hospital's physical design becomes a crucial element of patient health, comfort and well-being. Good hospital design can reduce these risks. Installing a dedicated hand washing sink near the entrance of a patient room has been demonstrated to improve hygiene, which reduces the instances of infection. Proper lighting and layouts reduce potential distraction during preparation of medications, to help prevent drug administration errors. Well-placed handrails, the space to limit clutter, and flooring materials that reduces slipperiness and unevenness, will help prevent patient falls.

XIV. **Design for Flexibility:** Flexibility must be a basic feature of any new




Left: Ambient outer lounge helps the patient's relatives destress.
Right: Double heighted Biophilic Foyer at Tower Rush Medical Center, Chicago, Illinois, USA

health care facility to keep it from rapid obsolescence in the face of changing needs and technologies. Net usable program space is at a maximum in schematic design. Oversizing at first helps in ensuring that it can meet program needs in the end. For instance, Detroit Medical Centre situated in Michigan, USA, replaced the rigid copper piping running through walls with a solution that matched the flexible nature of building. This helped them add new outlets without shutting down the system. Use of flexible hoses that are virtually impossible to penetrate is the key. The flexible system weathers a seismic event with greater structural integrity than copper lines. This keeps critical systems online when they're needed most.

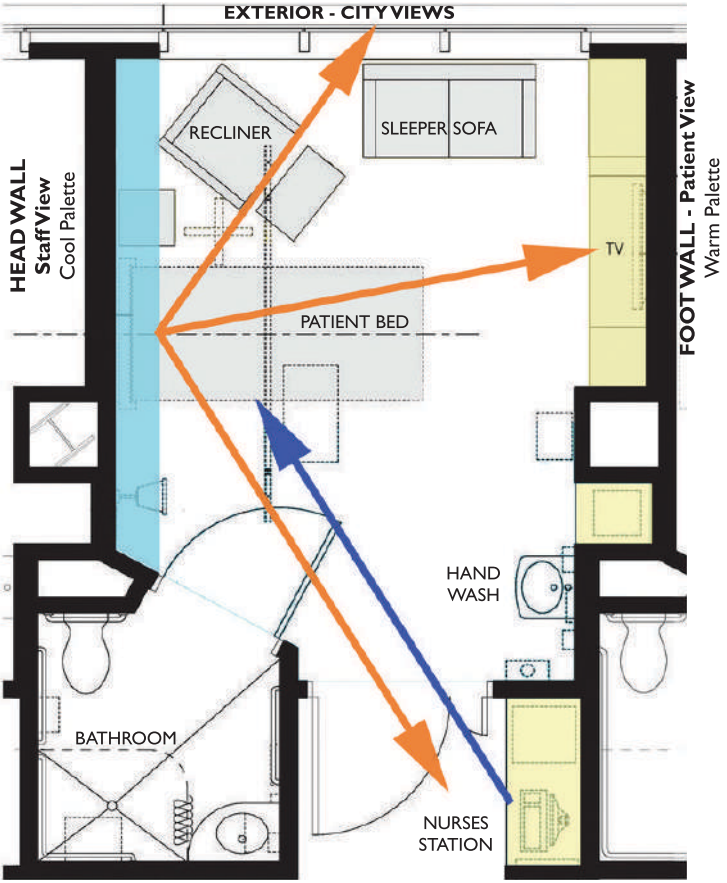
XV. **Design for Brightness:** For a good hospital design, lighting remains specifically important for growing an interesting ecosystem. Besides natural day light, planting or artworks displayed in those areas need to be well illuminated with synthetic lighting fixtures at night time.

XVI. **Design without Limitations:** Designing beautiful hospital always remain a challenge, especially on a tight budget, but the importance of creating really well-designed spaces also remains important. Lots of daylight and views, simple organization and lovely distractions can result in a good design. Visual environment is known to have a fantastic effect at the occupant's feeling, workforce performance and patient recovery; uplifting the spirits of the staff, patients and visitors.

XVII **Architecture & Campus Design:** Good campus planning and

architecture allows the layout of streets, building approach and building entries to serve as way-finding devices- trying to read signs while driving. Vehicular access and approach roads should be designed to clear /alleviate stress on the commuters. Scale, lighting /materiality for the main entry to the hospital, parking structures / office buildings must put patients / families on the quickest path to the front door. Locating vertical circulation towers / major public spaces near main entries help those arriving at night, signaling to patients and families where to go with clearly illuminated entrances.

→ **Welcoming Design Aesthetic:** Good hospital design reflect both the region and the visual and cultural ethos of the institution. Today, many



TYPICAL ACUTE CARE PATIENT ROOM

institutions reference elements of hospitality design when discussing their vision for new buildings includes; covered drop-offs with valet parking, open and transparent lobbies and public spaces, and warm, natural materials that evoke a sense of comfort. Check-in services are becoming more common. Art and sound play a key role in creating calming and welcoming aesthetic and providing positive distractions upon arrival.

→ **Parking Pick Up and Drop Off:** There is no better way to feel that you are being taken care of – pampered even – than by eliminating all worry of arrival, drop-off and parking. Free valet services reduce stress of finding a space, paying and returning to your car. An expanded vehicular drop-off and pick-up area accommodates these services. It is also adaptable for ride-share and a potential autonomous car revolution. With more patients and visitors utilizing alternative arrival methods, this drop-off sequence will become more important than ever before as parking garages shrink or are converted to other hospital functions.

→ **Planning For Better Waiting Area-** Waiting room is one of the most stressful parts of the visit so make it an amazing place to be: provide expansive views, windows for daylight, art and beautiful, comfortable furniture. Locating waiting areas along the perimeter is an effective way to promote way-finding and mitigate patient and family stress.

→ **Making Pleasant Clinical Environment:** Patients and staff benefit from well-designed clinical areas provided with natural daylight, art, material and views creating a calming and healing environment.

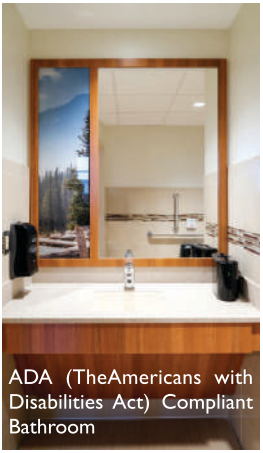
→ **Universal Accessibility:** All hospital spaces should be planned, designed, and constructed to provide universal barrier free, hassle free, non-slippery accessibility to all visitors, users, patients, doctors and staff.

→ **Healthy Building - Healthy Occupants:** Healing happens inside hospitals and the building itself should participate in that healing process. Materials providing clean and filtered air, offering access to outside experiences with operable windows or terraces in places where immune systems are not compromised, are all strategies for healthier buildings. Looking beyond patients to a healthier planet, excess heat, rain and wind should be captured and stored for use. Since hospitals are mission critical facilities and need to remain open and accessible after events like wildfires, tornados and earthquakes, the perfect hospital is a standalone, net zero, resilient structure.

XVIII **Designing Patient Rooms:** Rational design of patient rooms remains critical in patient care and accordingly must form an important part of hospital design strategy. Patient room should be designed with maximum visibility, achieved with cameras, windows into rooms from charting alcoves (this will allow visibility without disturbing the patient),


Standard Room - Tower Rush Hospital, Chicago


Oversized windows for more sunlight



ADA (TheAmericans with Disabilities Act) Compliant Bathroom

Disabled friendly bathroom at Hudson River Healthcare, New York, USA

Interiors of Nursing Staton using custom Millwork

The "truly" standardized patient room reflects the following safety design features aimed at creating a safe, high quality, patient centric environment:

→ Charting alcove with window to increase patient visibility for nurses, physicians, and staff.

→ Oversized windows allowing more natural light into the patient room and creating a better healing environment.

→ Wiring for cameras in every room.

→ Standardization in room size, equipment, supplies and mirrored image layout

→ Improved technology including EMR and CPOE to reduce medication errors; an advanced nurse call system (including wireless phones); and a bed exit system to reduce patient falls.

→ Ceiling heights and room size to allow for easy expansion.

→ Noise reduction using low vibration steel, special noise absorbing ceiling tiles, and no overhead paging.

→ Bedside computers allowing patient access to records and involvement with care as well as providing caregivers convenient access to patient information.

→ Sitting area and guest foldout bed to encourage family support and involvement with care.

→ In-room sink allowing physicians and staff to wash hands (within patient

view) to reduce the spread of infections.

- → Close proximity between bed and bathroom with railing support to reduce the probability of patient falls.
- → Special "break away" bathroom fixtures to reduce suicide attempts.
- → Bathroom at the head of the patient's bed, allowing the patient to get to and from the bathroom without impediments, holding onto a rail all the way if necessary
- → Designing rooms in a mirrored image layout where a nurse can view four patients from one location in the hallway.
- → Rooms and bathrooms to be designed larger than a traditional patient room for ease in movement between bed and bathroom. A larger room can also include a comfortable space for family members, which will encourage family involvement and provide additional patient monitoring
- → Minimize risk to vulnerable patients include standardization of equipment, and the use of common monitoring systems and intravenous pumps.
- → Focus on patient safety. It is important to have a set of safety driven design principles to guide the design process

XIX **Designing Green Hospitals:** Designing green hospitals will be critical to make hospitals role model of;

- → Creating "Hassle-free" hospitals
- → Enhancing patient care by promoting staff efficiency
- → Evolving Energy efficient design
- → Consuming less energy per bed / month
- → Marking a shift in attitude from treatment to prevention
- → Making Hospitals--that breathe and meet climate challenge
- → Minimizing operating costs
- → Maximizing resources available for patient care
- → Incorporating ventilation and exterior envelope strategies in building design
- → Creating permeable "breathing" building that allows Air- flow both horizontally and vertically- throughout building.

Green Features at Rush University Medical Center, Chicago, USA
1- Tower AHUs : 2-Cistern : 3-Green Roof : 4-Central Plant

→ Reducing overall area of building- needing mechanically cooling.

→ Using orientation / exterior detailing / interior planning to reduce (only 30%) Hospital area requiring air conditioning.

→ Minimizing heat gain of area requiring air- conditioning by co-locating/combining -- operating rooms/ laboratories,

→ Ancillary spaces balconies / circulation- designed for natural ventilation

→ Green roofs, green walls / landscaping used to help lower heat gain

→ Hospital's east-west facades - fitted with intricate sun screens- to shield perimeter from direct sunlight.

→ fenestration on north-south which receive less sun should incorporate light shelves to redirect light deeper into building to reduce heat gain from artificial lighting.

→Portions of building shaded by deep overhangs, to remain largely transparent and maximize daylight and views.

→ Placing all spaces requiring air conditioning on the cooler side- north.

→ Alternative energy sources used for on-site co-generation plant

6. WAY FORWARD

Health-care remains the bonafide right of every individual and it is the duty of every nation to provide a cost-effective, qualitative, time bound and safe, health care to all its residents without any discrimination. With population recorded at 1.21 billion in 2011, , there were 1,56,231 Sub Centres, 25,650 Primary Health Centres and 5,624 Community Health Centres in India as on 31st March 2017 to cater to nation's health needs (as per National Health Profile-2018-13th edition, issued by Central Bureau of Health Intelligence, MOH&FW, GOI).

In addition, India recorded 3,215 Institutions producing 1,29,926 General Nurse Midwives annually and 777 colleges for Pharmacy (Diploma) with an intake capacity of 46795 as on 31st October, 2017 . There were also 23,582 hospitals having 7,10,761 beds in the country out of which 19,810 hospitals are located in rural area with 2,79,588 beds and 3,772 hospital are in Urban area with 4,31,173 beds. Medical education infrastructure in the country has also shown rapid growth during the last 26 years. The country presently has 476 medical colleges, 313 Dental Colleges for Bachelor in Dental Studies (BDS) & 249 Dental Colleges for Masters in Dental Studies (MDS). There has been a total admission of 52,646 in 462 Medical Colleges and 27,060 in BDS and 6,233 in MDS during 2017-18.

However, there are very limited number of Architectural/Engineering institutions in the country imparting dedicated education/expertise in the planning, designing and construction of healthcare institutions. As per studies made, India is on the path of becoming the most populated country in the world, relegating China to the second position. India's population graph is likely to show a population of 1.4 billion by 2030 and1.6 billion by the year 2050. Urban population to be recorded is estimated to be 600 million in 2030 and 800 million in 2050 when Urban and Rural India will share parity in population they will be holding. Considering the rapid growth in population and massive urbanization, India will additionally need a very large number of healthcare institutions across the nation, covering all its villages and urban centres. As already said, well-planned and well-designed healthcare institutions not only makes healthcare qualitative, time-efficient but also affordable.

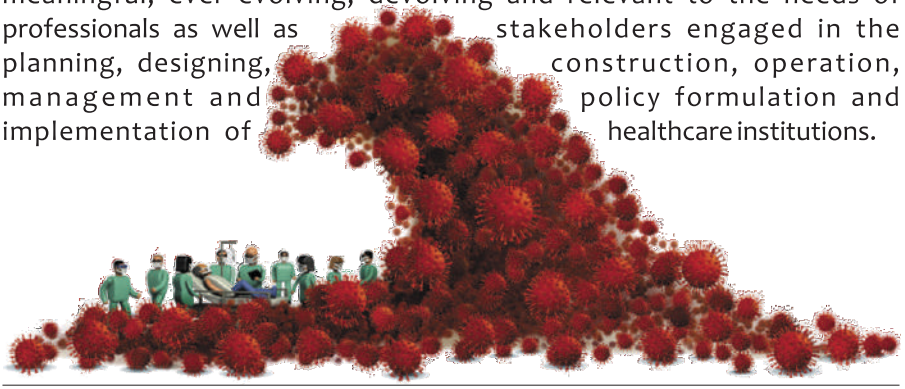
Accordingly, it will be important that a well-designed framework, duly supported by quality manpower,

needs to be laid down for creating State of the Art planned and designed healthcare institutions. This will help nation save enormous resources not only in construction of such institutions but would also go a long way in making the nation healthy and more productive. It is time nation should understand the role and importance of creating well-planned and well-designed healthcare institutions to promote sustainable healthcare sector in the country.

All these institutions need to be planned and designed as zero-energy, zero-water and zero-waste institutions to make them not only sustainable but also to help in changing the context of our healthcare culture from Curative to Preventive. To achieve this objective, Government should think of launching specialized courses dedicated to planning, designing, construction and management of Healthcare institutions in the country in all campuses of IITs, SPAs, NITs, AIMS, National Institutes of Excellence in Healthcare to create quality resource personnel for the sector.

This brief write up, with all its limitations, is an attempt to define certain basic principles, essentials for planning and designing of any healthcare institutions. It is hoped that contents of this writings will have some relevance, particularly in the present scenario of pandemic created locally and globally by the Covid-19 where healthcare institutions remain the most valuable institutions to address this crisis.

The professional architects have here an opportunity to design healthcare institutions and students of architecture taking healthcare institutions as the topic of thesis in the final year of architecture will augur well for this sector. My constant endeavor shall remain to make this document more comprehensive, meaningful, ever evolving, devolving and relevant to the needs of professionals as well as stakeholders engaged in the planning, designing, construction, operation, management and policy formulation and implementation of healthcare institutions.



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ABOUT THE AUTHOR

An emeritus academician with an experience of over five decades in architecture, Ar Jit Kumar Gupta has also taught at foreign universities in USA, China, Nepal and Bhutan.

A former advisor to Dept. of Town Planning, Punjab Urban Planning and Development Authority & Founder Director, College of Architecture, IET Bhaddal, Punjab, he also finds time teaching at architectural institutes of eminence across India, which includes, CCA Chandigarh, IKG PTU Campus Kharar, SPA Vijaywada, NITTTER Chandigarh, MGSIPA Chandigarh, HIPA Shimla, CRRID Chandigarh, SMVDU Katra, GZCET Bathinda, DCRUST Murthal, LPU Jalandhar, Jamia Millia University Delhi.

An author of over 250 papers and books, he has also served as member of the prestigious working group of the Planning Commission of India during the Ninth Five Year plan.

jit.kumar1944@gmail.com

9. WHAT'S THE GOOD WORD

Acroteria : *A pedestal at the corners and peak of a roof to support a statue of ornament.*

Antefix : *A decorated upright slab used in classical architecture to close or conceal the open end of a row of tiles that cover the joints of roof tiles.*

Arcade : *A series of arches supported by columns or piers; a building or part of a building with a series of arches*

Architrave : *The ornamental buildings around the faces of the jambs and lintel of a doorway or window.*

Bas-reliefs : *A carving, embossing, or casting moderately protruding from the background plane, derived from the French meaning "low-relief".*

Bearing wall : *A wall that carries a portion of the build's weight.*

Belvedere : *A roof top pavilion from which a vista can be enjoyed, from the Italian meaning "beautiful view".*

Bifora : *A double arched opening within a larger arched frame*

Brace : *A metal or wood member, which may be curved (portal) or straight (knee), and is used to stiffen or support a structure.*

Bundled tube : *A structural system consisting of closely spaced columns tied together for strength, which, used at a building's outer wall, act as the walls of a hollow tube. The Willis tower uses this system.*

Cantilever : *A projecting beam or part of a structure that is supported at only one end.*

Cartouche : *An ornamental panel in the form of a scroll, circle, or oval bearing an inscription.*

Cast Iron : *Smelted iron, shaped in a mould, who's compressive or load bearing strength made it an important structural metal.*

Cavetto : *A concave surface or moulding about a quarter of a circle in section, often used in cornices, especially in Egyptian architecture.*

Chicago Window: *A window flanked at each side by a narrow movable sash and occupying the full width of the bay in which it is placed.*

Coffering : *A ceiling with deeply recessed, often highly ornamented panels.*

Console : *A decorated bracket in the form of a vertical scroll, projecting from a wall to support a cornice, door, or window head.*

Cornice : *A projecting ornamental moulding along the top of a building, wall or arch, finishing or crowning it.*

Crocket : *Element of Gothic architecture, an upward oriented ornament, often vegetal in form, regularly spaced along sloping or vertical edges of spires, pinnacles or gables*

Esplanade : *A level open space for walking or driving, often providing a view.*

Flying Buttress : *A bar of masonry, usually sloping, carried on an arch, abutting a solid pier sufficient to receive the thrust of a roof or vault. A characteristic feature of Gothic construction.*

Footprint : *The outline of a building at the ground*

Light Well : *An open area in the centre of the building used to provide natural light and ventilation, before the widespread use of electricity and air-conditioning, for the rooms and offices contained in the surrounding sides of the building.*

Mullion : *A vertical member separating and often supporting windows, doors or panels set in a series.*

Ogee : *A double curve resembling an S-shape formed by the union of a convex and a concave line.*

Oriel : *A protruding window*

Pediment : *In classical architecture, the triangular gable end of a roof above the horizontal cornice; more commonly, the triangular or curved ornament used over doors or windows.*

Pony Truss : *A low support without any overhead bracing. Structural supports are above and below the roadway*

Quarterfoil : *A four-lobbed pattern divided by cusps.*

Rustication : *Masonry cut in rough, massive blocks separated from each other by deep joints.*

Setback : *An architectural element in which the upper stories of a tall building are stepped back from the lower stories to permit more light to reach street level.*

Skeleton Frame : *A freestanding structure of iron or steel that supports the weight of a building and on which the floors and outer covering are hung.*

Soffit : *The underside of any architectural element.*

Spandrel : *In a multi-storey building, a wall panel that fills the space between the top of a window in one storey and the still of the window in the storey above.*

Tempietto : *A small temple, especially one of ornamental character, resembling those built during the Renaissance.*

Terra cotta : *Cast and fired clay units, usually more intricately modelled than bricks, used for decorative and/or fireproofing architectural purposes.*

Truss : *A structure composed of a combination of members, often steel or iron, usually in* some triangular arrangement so as to form a rigid *framework.*

10.WORD PLAY AT CONSTRUCTION SITES

Terms commonly used on construction sites in Western India

LABOUR

Bai	बाई	female labourer
Bar-bender	बारबेन्डर	helper for a fitter, or a fitter
Begari	बेगारी	unskilled labourer
Fitter	फीटर	reinforcement fixer
Helper	हेल्पर	helper for any skill
Mistry	मिस्त्री	skilled mason
Mukadam	मुकादम	foreman
Suthar	सुथार	carpenter

MATERIALS

Eent	ईंट	brick
Fali	फल्ली	wooden plank
Ghodi	घोडी	chair to support top jali
Guni, Goni	गुणी / गोणी	gunny bag for cement, used as a measure
Jali	जाली	reinforcement grid for foundations or slabs
Khadi	खडी	aggregates
Kursi	कुरसी	chair to support top jali
Laafa	लाफा	wooden batten
Maal	माल	mixed concrete or mortar
Peti	पेटी	box of formwork for a footing
Plowed	पीलायवुड	plywood
Rabid	राबिड	debris
Reti	रेती	sand
Ring	रींग	stirrups for columns or beams
Sareea	सरीया	steel rod
Thesi	टेसी	battens in a square for a starter for a column or stub

EQUIPMENT AND TOOLS

Chhini	छीनी	heavy chisel for masonry or concrete
Durbin	दुरबीन	theodolite
Farshi	फरसी	chisel for wood
Ghamela	घमला	pan for transporting excavated earth, concrete etc
Ghoda	घोडा	stepladder
Hathodi	हथोडी	hammer
Kaat-kona	कातकोना	square
Karvat	करवत	saw
Khila	खील्ला	nail
Level-pipe	लेवलपाईप	pipe-level with water
Line-dori	लाईनदोरी	nylon or twine for marking base-lines
Olamba	ओलमबा	plumbline

Parai	पारइ	digging rod, with a sharp point
Paranchi	परांची	scaffolding
Pharma	फरमा	box for transporting sand, aggregates, a measure
Phawda	फावड़ा	spade
Randa	रंदा	plane for wood
Tacha	टाचा	wedge-shaped hammer
Thapi	थापी	trowel
Tikam	तीकम	pick axe
Tube level	ट्युब लेवल	pipe-level with water

PROCESSES

Baandh-kaam	बांधकाम	brick masonry work
Bharai	भराई	backfilling
Khachi	खाची	rodding concrete for compaction
Khodai	खुदाई	excavation
Tachi	टांची	to mark fresh concrete before concreting

STRUCTURAL MEMBERS

Bhim	बीम	beam
Chajja	छज्जा	sun and weather shade
Kalum	कॉलम	column
Paradi		two-way reinforced RC wall

WORDS THAT REMAIN THE SAME

Bhim	बीम	beam
Cement	सीमेन्ट	cement
Form	फॉर्म	formwork
Foundation	फाउन्डेशन	foundation
Kalum	कॉलम	column
Kancreet	कॉनक्रीट	concrete
Mixer	मिक्सर	concrete mixer
Shuttering	शट्टरींग	shuttering
Vibrator	वाइब्रेटर	concrete vibrator for compaction of concrete
Wire	वायर	binding wire, electric wire or cable

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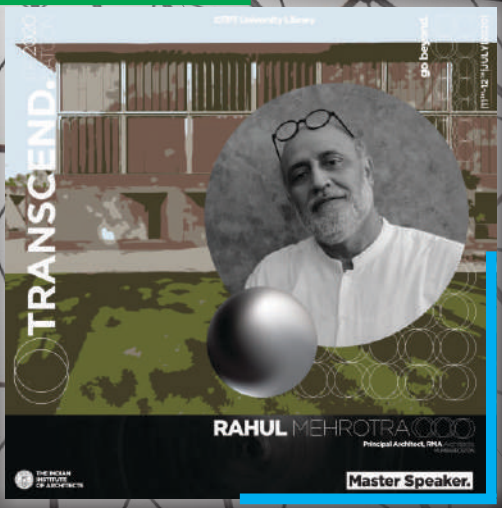

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