Area Requirement Analysis and Zoning Criteria for Architectural Programming of Healthcare Buildings in India

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Abstract: A hospital is a place of health care that offers patient care using professional medical and nursing personnel and equipment. A healthcare building comprises many departments including Emergency, Out Patient Department (OPD), In-Patient Department (IPD), Diagnostic, Surgery and other Specialties. Design of a healthcare building is a challenging task and students / professionals often remain clueless about the applicable standards and approach of architectural design for such buildings. Building services, materials and the maintenance aspects make the task further complex. An attempt has been made to present the aspects related to space requirements for healthcare building before the user group. The objective of this study is to explore and analyse the space requirements of healthcare buildings as per applicable standards and established practices. The room wise comprehensive area requirements for various zones are proposed which can be considered as ready reckoner. Such a database shall facilitate the students of architecture, architects building industry professionals involved in the design of hospitals and healthcare buildings. Various books, documents, standards and codes related to design and requirements of healthcare facilities of various types/magnitudes were studied, together with the manufacturer's data for various Equipment. A comprehensive study of various space requirements for different departments in the hospital buildings was carried out and inferences and design implications were drawn. The area charts are prepared for all the zones of a hospital building considering the common amenities and circulation areas, appropriately. The relationship chart is prepared to graphically represent the outcome. There were gaps in the literature available so far and zone or department wise comprehensive area requirements were not available and hence user group were to struggle to formulate area statements for a hospital building. This paper presents the room wise area requirements for various zones in hospital building in comprehensive manner, which can be used as ready reckoner by architects and building professionals.
***Keywords*:** Area analysis, Zoning, Architectural programming, Hospitals, Healthcare buildings, India

1. Introduction

A hospital is a place of health care that offers patient care using specialised medical and nursing staff as well as medical supplies. A clinic is a less expansive medical facility than a hospital. There are numerous departments at the hospital, including ones for surgery and urgent care, as well as specialised ones like cardiology. Throughout this phase, a hospital is constructed, staffed, and furnished for illness diagnosis, medical and surgical care of the ill and injured, and housing. The contemporary hospital is regularly used for both research and instruction. More initiatives are needed in the healthcare industry, as well as new organisational and physical models, in order to fulfil the rising demand and enhance service quality (Brambilla et al., 2022). Patients heal more quickly, spend less time in the facilities, and are more satisfied with the care they receive when a healthcare facility is designed to provide a peaceful healing atmosphere for the patients (Hassanain et al., 2022).

Studies have demonstrated a significant relationship between a person's physical surroundings of residence or place of treatment and their health and well-being (Zhao & Mourshed, 2012). It is widely accepted that healthcare facilities should offer sufficient amenities, spaces, and a secure atmosphere for the patients and carers who spend the majority of their time there as a patient. Consideration for a built environment that feels like home, is aesthetically pleasing, has space for family and friends, is noise-free, has rooms exposed to nature, allows access to healing gardens, and promotes healthcare outcomes. These factors, along with better culture and better care, improve patient experience, which has a positive effect on patient satisfaction. Safeer et al. studied the person-centered care design facility with reference to the healthcare outcomes in Saudi Arabia has been studied (Safeer et al., 2020). A mix of public and private health care service providers make up India's healthcare system. Based on population norms, a three-tiered system of public health care has been designed in rural areas. The number of hospital beds needed, which is a function of the size of the population it serves, determines the size of a hospi-

tal. As per the Indian Public Health Standards (IPHS, 2012), the calculation of number of beds is based on following aspects:

(a) Annual rate of admission as 1 per 50 populations.

(b) Average length of stay in a hospital as 5 days

For instance, in India, a district can have anywhere between 50,000 and 15,000 people living in it. For convenience, the district's average population is assumed to be one million people. Based on the assumptions the number of beds required for 10,00,000 population is:

(a) Number of bed days per year: (10,00,000 x 1/50) x 5 = 1,00,000

(b) Number of beds required with 100% occupancy: 1,00,000 / 365 = 275

(c) Number of beds required with 80% occupancy: (1,00,000 / 365) x 80% = 220

The Department of Health and Family Welfare advises putting trauma centres along the roads that span the boundaries of urban local authorities. The trauma care facilities should be strategically placed along the roadways, equipped with doctors skilled in emergency medicine and trauma treatment, enough emergency management personnel, and an effective ambulance system (MoUD, 2015). Indian Public Health Standards (IPHS) are a set of uniform standards envisaged to improve the quality of health care delivery in the country (DGHS-GoI, 2010). There are 578 District Hospitals in 636 Districts in India. The IPHS materials have been updated to reflect the introduction of new programmes, particularly those for non-communicable diseases, as well as changes to the existing programmes' protocols. To accommodate the various needs of the States and regions, flexibility is permitted. These IPHS principles will serve as the primary impetus for ongoing equity improvement and as the standard for evaluating the operational viability of healthcare facilities. States and UTs should follow these IPHS recommendations in order to enhance public health care institutions and make every effort to provide high-quality healthcare nationwide.

A revolution in architectural design, manner of thinking, and spatial configuration is necessary for sustainable healthcare projects. Thus, it is crucial that this evolution, which affects buildings at every point of their lifespan, be reflected in the early stages of architectural design and at the core of the discipline—the design and organisation of space. Architectural design should create synergy amongst all members of the design team and take into account all users' and patients' expectations as well as environmental issues. Dubey amd Kamal evaluated the energy efficiency of a trauma centre in India with reference to the green rating system, GRIHA (Dubey & Kamal, 2022). Hospitals can be compared and classified in a variety of ways, including ownership and control, type of service provided, length of stay, size, and facilities and administration provided. General hospitals, specialized hospitals, short-stay hospitals, and long-term care facilities are some examples.

Healthcare facilities are classified by Govt of India (CPWD MoHUA, 2019) as follows:

(a) Sub-Centres

(b) Primary Health Centres

(c) Community Health Centres

(d) Sub-District Hospitals

(e) District Hospitals

(f) First Referral Units

The scope of this work is to analyse the area requirements of a district level hospital, as per IPHS. According to the hospital definition, a district hospital is often the principal healthcare centre for a given area, with lots of intensive care beds and extra beds for patients who need long-term care. For treating particular medical disorders like psychiatric care, specialised hospitals and disease categories include trauma centres, children's hospitals, rehabilitation hospitals, hospitals, and seniors' (geriatric) hospitals. Compared to normal hospitals, specialised hospitals can assist reduce the cost of medical care. Depending on their source of funding, hospitals are categorised as general, specialist, or government facilities.

1.1 Background and Significance of Research

Although architects and building professionals strive to design healthcare facilities to facilitate all stakeholders, however studies on spare needs perspectives linked to built environment design elements in healthcare are scarce. Few studies have looked at the kind of elements patients believe are crucial to their health and wellbeing, as well as the breadth of those aspects. Yet, the impact of these elements on healthcare facility design and how they might be properly incorporated into the facility design process have largely gone unnoticed. Also, patients' perceptions and expectations are shifting as a result of their increased knowledge about healthcare. Therefore, this research is aimed to explore and analyze the space requirements of healthcare buildings as per standards and established practices; and propose room wise comprehensive area requirements for various zones which can be considered as ready reckoner, to facilitate the architecture students and building professionals involved in the design of healthcare buildings.

Past decades have witnessed significant progress in the development of healthcare facilities through the spatial transfor-

mation, the evolution of diagnostic and treatment technologies, and future functional requirements. Designers and architects have the responsibility to provide an adaptable built environment that provides the best care for the patient (Eltahlawy et al., 2022)the evolution of imaging technologies, and future functional requirements. Designers and architects who specialize in healthcare must provide a modern, adaptable built environment that provides the best care for the patient. As a result, the research focused on discussing that problem through three main axes: (the first axis. The body of research on consumers' perceptions of physical surroundings in the context of healthcare is lacking. Furthermore, the relationship between care services and the facility's architecture is frequently disregarded, in part because there is a lack of supporting data (Zhao & Mourshed, 2017). Researchers have examined the advantages of contemplative space simulations for patient care quality, patient experience, and provider experience, in addition to the cost and time advantages (Register et al., 2019). The space requirements for various functions in a healthcare building are increased over the years. Majority of existing hospitals still use at least portions of their physical plants that were constructed before the year 2000. Since then, of course, layers of regulations have been added that influence how spaces are constructed. Changes in technical and medical protocols have become a constant aspect of the dynamics of healthcare buildings, and we have witnessed it during COVID-19 pandemic. In addition, focus on increased safety in inpatient settings has fuelled further changes in space needs. Understanding these changes is the key to mitigating the challenges and effects on the promoter and user groups when designing new health care spaces.

The Indian government is committed to enhancing the health care system in order to raise population health standards. Many actions have been made in the post-independence era to that objective. Strengthening referral services and offering specialty services at district and sub-district hospitals is one such initiative. The district headquarters hospital is home to a number of specialists, including a surgeon, physician, obstetrician and gynaecologist, paediatrician, orthopaedic surgeon, ophthalmologist, anaesthetist, ENT specialist, and dentist. In comparison to the vast amount of research that has been undertaken and published on many other aspects of the healthcare environment in relation to occupants' safety, well-being, and health status, there is a dearth of systematic research on this topic (Jiang & Verderber, 2017). Further research is needed to examine how the efficiency of patient care is impacted by physical layout decisions (Vahdatzad & Griffin, 2016). Adequate spaces are very much required for various functions for healthy relationship between physical layout with flexible patient flows and standard operating procedures. Service delivery in the healthcare sector is profoundly affected by the built infrastructure and spaces provided to support these (Abdel Wahed et al., 2011). A reliable, systematic framework to evaluate the infrastructure is a must. Developing such a ready reckoner toolkit in the form of space requirements checklist for healthcare facilities in an attempt to facilitate the building professionals, shall certainly help in enhancing user experience of all stakeholders in healthcare facilities.

1.2 Grading and Typology of District Hospitals

A district hospital's size depends on the number of hospital beds needed, which in turn depends on the size of the population it serves. A district's population in India might range from 35,000 to 30,000. (CPWD MoHUA, 2019). According to the assumptions that the annual rate of admission is 1 per 50 inhabitants and the typical hospital stay is 5 days, a district with a population of 1 million people will need about 300 beds. Yet because the district's population varies greatly, it would be wise to set standards by ranking the size of the hospitals according to the number of beds.

(a) District hospitals norms for 500 beds are categorized as Grade I
(b) District Hospital Norms for 400 beds are categorized as Grade II
(c) District hospitals norms for 300 beds are categorized as Grade III
(d) District hospitals norms for 200 beds are categorized as Grade IV
(e) District hospitals norms for 100 beds are categorized as Grade V

1.3 Bed Distribution Configuration

Table 1. Suggested distribution of beds in various wards

S. No.	Item	Type	District Headquarters Hospital		
			100-200 Bedded	201-300 Bedded	500 Bedded
1	General Medicine	Beds(M+F)	15 + 15	25+25	40+40
2	New born ward	Beds	5	5	10
3	Mothers room	Beds	5	5	10
4	Pediatric ward	Beds	10	20	40
5	Critical ward	Beds	5	10	10

S. No.	Item	Type	District Headquarters Hospital		
			100-200 Bedded	201-300 Bedded	500 Bedded
6	Isolation ward	Beds	4	5	5
7	Dialysis Unit	Beds		3	3
8	Thoracic medicine ward	Beds(M+F)		5+5	10+10
9	Blood bank	Beds	Yes	Yes	Yes
10	General Surgery ward	Beds(M+F)	15+15	25+20	35+35
11	Post-operative ward	Beds(M+F)	10 + 16	10+10	15+15
12	Accident and trauma ward	Beds	10	10	15
13	Labor room	Beds	3	8	8
14	Labor room (Eclampsia)	Beds		3	3
15	Septic labor room	Beds		2	2
16	Ante natal ward	Beds	15	15	30
17	Post partem Ward	Beds	20	30	50
18	Post-operative ward	Beds		20	40
19	Ophthalmology ward	Beds	5	10	20
20	Burns ward	Beds		5	10
21	Post-natal ward	Beds	15	15	30

NOTE: It is recommended that 5-10 beds may also be planned for the treatment of patients under AYUSH (Ayurveda, Yoga, Unani, Siddha and Homeopathic), as per Indian Standards/Practices.

1.4 Different Departments in Hospital

Various departments found in hospitals include the following:

(a) Out Patient Department (OPD)
(b) Inpatient Department (IP)
(c) Department of Surgery
(d) Department of Nursing
(e) Department of Physical Medicine
(f) Department of Paramedical Sciences
(g) Department of Rehabilitation
(h) Department of Dietary
(i) Department of Pharmacy
(j) Operation Theatre (OT)
(k) Department of Radiology (X-ray)
(l) Administrative Department

2. Research Methodology

In order to meet complex adjacency/closeness requirements in response to programmatic needs, project site specifications, surrounding buildings, as well as environmental requirements like daylight and waste management, hospital designs typically require systematic design methodologies and computational design tools. This study focuses on the quality of diverse spaces and how their organisation, flexibility, and adaptation might be crucial for people's wellness and for the best possible results. It also examines the space design standards of healthcare buildings. Various books, documents, standards and codes related to design and requirements of healthcare facilities of various types/magnitudes were studied. Comprehensive study of room wise space requirements for various departments in the hospital buildings is carried out and inferences are recorded. Area charts are prepared for all the zones of a hospital building considering the common amenities and circulation areas, appropriately or as recommended by IPHS (DGHS, 2010). The tables and charts are reviewed thoroughly by 3 professionals for any addition or omissions required. The graphical model is prepared to illustrate the findings and presented in the manner which is easy to understand by the user group i.e. students and building professionals. The different zones and area requirements of different departments are presented from Table 2 to Table 20.

Table 2. Suggested area of administrative department

Administrative Unit			
Medical Supdt (M.S) room	1	42	42
Dy/Asstt. Medical Supdt. Room	1	21	21
P. S. to Medical Supdt/ Dy MS./ Asstt. M.S	1	11	11
Admin Officer	1	11	11
Waiting Room	1	11	11
Library-cum Conference Room	1	11	11
Nursing Officer's room with toilet	1	28	28
Accounts Officer	1	11	11
Cashier	1	11	11
Purchase Officer	1	11	11
Clerical Staff	1	35	35
Reception cum Enquiries	1	18	18
Welfare/Labour Officer	1	21	21
Security Officer	4	21	84
Staff Toilets (Separate for Male and Female)	1	35	35
TOTAL			361

Table 3. Area program of medical records (administrative department)

Medical Records Department			
Medical Records Store - Active up to 2 years	1	56	56
Archive (Between 2 to 10 years)	1	140	140
Medical Records Officer with toilet	1	18	18
Staff Office with toilet	1	18	18
Medical Record Processing area	1	35	35
Doctors Record Completion room	1	14	14
Room for various automations	1	14	14
Printed Stationery store	1	14	14
General store	1	14	14
TOTAL			323

Table 4. Area requirements of CSSD

Central Sterilization and Supply Department			
Bulk storage	3	18	54
Officer-in-charge with toilet	1	18	18
Technicians room with toilet	1	18	18
Receipt counter	1	11	11
Dissembling and Decontamination	1	11	11
Washing and cleaning	1	11	11
Assembly and Set packing room	1	28	28
Gloves preparation room and Gauze cutting area	1	18	18
Autoclave area	1	28	28
Hot air-oven room	1	11	11
Sterile store	1	35	35
Issue counter	1	18	18
Class IV room	1	11	11
Trolley bay	1	11	11
Switch room	1	11	11
TOTAL			294

Table 5. Area requirement for dietary unit

Dietary Unit			
Reception area	1	42	42
Cooking area	1	84	84
Therapeutic diet preparation and cooking area	1	18	18
Dietitian with toilet Stewards and Staff with toilet	1	18	18
Trolley loading	1	14	14
Walk in cold storage	1	11	11
Dry ration storage	1	11	11
Washing areas	1	14	14
Pots	1	18	18
Trolleys	1	18	18
Dishes	1	18	18
Garbage collection area	1	11	11
Switch room	1	11	11
TOTAL			288

Table 6. Area requirement for laundry unit

Laundry Unit			
Dirty clothes receiving and sorting area (with weighing facility	1	50	50
Sluice and autoclaving machine area	1	14	14
Washing area	1	56	56
Hydro extractor	1	56	56
area Drying tumbler	1	56	56
area Calendaring	1	56	56
machine area	1	28	28
Tailor desk	1	14	14
Steam pressing	1	28	28
Manual press area	1	28	28
Clean clothes storage area	1	35	35
issue area	1	28	28
Boiler room	1	21	21
Trolley bay	1	14	14
Store	1	21	21
Laundry supervisor office with toilet	1	18	18
Laundry staff room with toilet	1	21	21
Switch room	1	7	7
TOTAL			551

Table 7. Area requirement for storage facility

Hospital Store			
Receipt of stores (weighing, inspection, testing)	1	28	28
Medical store	1	91	91
General store	1	42	42
Linen store	1	56	56
Furniture store	1	84	84
Surgical store	1	56	56

Hospital Store			
Equipment store	1	84	84
Areas for storage of mechanical transport spares	1	84	84
Area for storage of articles awaiting condemnation	1	56	56
Store office room with toilet	1	18	18
Office	1	56	56
Stationery store	1	28	28
TOTAL			683

Table 8. Area requirement for engineering workshop

Engineering Workshop			
Office	1	14	14
Painting area	1	28	28
Carpentry area	1	18	18
Electrician	1	18	18
Blacksmith	1	18	18
Store receipt	1	18	18
Stores for repaired equipment	1	18	18
Store room	2	14	14
			146
Areas for Vehicle Workshop			
Ambulance	7	21	147
Mortuary van	1	21	21
Tempo	1	21	21
Staff car	2	21	42
TOTAL			231

Table 9. Area requirement for common public facilities

Community Services			
Central admission office and hospital enquiry	1	14	14
Community centre	1	21	21
Chemist shop	1	21	21
provision store	1	21	21
Canteen	1	28	28
Snack bar	1	28	28
Fruit & Flower shop	1	14	14
News stand	1	14	14
Community hall	1	70	70
Bank	1	42	42
Post office	1	28	28
Library for patients	1	35	35
TOTAL			336

Table 10. Area program of mortuary

Mortuary Areas			
Cold room for body store (4 bodies)	1	11	11
Post mortem area	1	28	28

Mortuary Areas			
Autopsy store	1	14	14
Body wash and prayer room	1	28	28
Relative waiting area with toilet and drinking water facility	1	28	28
Doctor's office with toilet	2	18	36
Staff room with toilet	1	11	11
office	1	11	11
Stores	1	11	11
Janitors closet	1	4	4
Trolley bay	1	11	11
TOTAL			193

Table 11. Area requirements for OPD wing

Out Patient Department (OPD)			
Entrance lobby with reception, enquiry, cash counter, registration and record keeping	1	154	154
Officer-in-charge with toilet	1	18	18
Nurse-in-charge with toilet	1	18	18
Sanitary inspector room	1	14	14
Key room (security)	1	14	14
OPD medical record room	1	70	70
Canteen	1	49	49
Toilets separately for gents and ladies (common for patients and staff)	2	49	98
Janitor closet	1	11	11
Consultation and examination room	5	18	90
Cardiographic examination	1	18	18
waiting	1	84	84
Consultation and examination room	4	18	72
Treatment ,dressing or surgery	1	35	35
waiting	1	84	84
Plaster and splint storage	2	18	36
Fracture and treatment	1	18	18
Plaster cutting room	1	18	18
Recovery room	1	21	21
Consultation and examination	1	28	28
refraction room	2	18	36
Minor surgery and treatment room	1	18	18
Orthoptic cum Tomography	1	18	18
Dark room	1	18	18
Consultation	1	28	28
examination room	2	18	36
Treatment room	1	18	18
Audiometric room	1	18	18
Electronystagmography	1	18	18
Consultation and examination room	3	18	54
Dental hygienist room	3	18	54
Recovery room	1	28	28
Dental workshop	3	18	54
Processing room for x-ray	1	11	11
TOTAL			1359

Table 12. Area requirements for super specialities

Obstetric and Gynaecological			
Reception and registration	1	21	21
consultation and examination	3	18	54
Treatment	1	21	21
Clinical laboratories	1	21	21
Toilet-cum-changing	1	11	11
			128
Family Planning			
Consultation and examination	2	18	36
treatment	2	18	36
Health educator and social worker room	1	18	18
recovery	1	28	28
			118
Paediatric			
Consultation and examination	3	18	54
dressing treatment and dispensing	2	21	42
therapy room	1	18	18
immunisation room	1	21	21
recreation and play	1	18	18
			153
Skin			
Consultation and examination	2	18	36
Treatment rooms	3	18	54
biopsy room	1	11	11
Superficial therapy	1	18	18
Skin laboratory	1	28	28
Barber's room	1	7	7
			154
Psychiatric			
Consultation and Examination	2	18	36
ECT room	1	18	18
Recovery	1	18	18
Psychologist room	1	18	18
Social worker room	1	18	18
Electroencephalography room	1	18	18
Occupational therapy room	1	28	28
			154
Supporting Facilities			
Central injection room	1	21	21
Specimen collection room	1	21	21
Clinical laboratory	1	21	21
Social worker room	1	18	18
TOTAL			81

Table 13. Area program of blood bank

The Blood Bank			
Reception and waiting	1	28	28
Bleeding area	1	18	18
Donors rest room with kitchenette	1	18	18
Laboratory and blood storage area	1	28	28
office	1	11	11
stores	2	11	22
Bottle washing area	1	18	18
Doctors room with toilet	1	18	18
lavatory	1	11	11
Janitors closet	1	4	4
TOTAL			176

Table 14. Area requirements for pharmacy

Pharmacy Department			
Office with toilet	1	18	18
Dispensing area with issuing counter	1	18	18
Preparation and compounding area	1	18	18
Bottle Handling Area	1	14	14
Pharmacists room with toilet	1	18	18
Pre-packaging area	1	18	18
stores	2	18	36
Janitors closet	1	4	4
Trolley bay	1	14	14
TOTAL			158

Table 15. Area requirements of emergency and trauma unit

Accident and Emergency Department			
Drive in ambulance	1	18	18
Doctors duty room with toilet	4	11	44
Examination cubicle	1	11	11
Medico legal specimen and record room	1	11	11
Brought in dead room	1	18	18
Retiring room facility for ambulance driver and nursing staff	1	14	14
Electro-Cardiography room	1	14	14
Fracture treatment room with plaster preparation	1	18	18
Treatment room	1	14	14
Operation Theatre Complex			
OT	1	33	33
Instrument sterilization	1	11	11
Scrub-up	1	11	11
Dirty wash	1	11	11
Anaesthesia room	1	11	11
Resuscitation room	1	63	63

Accident and Emergency Department			
X-ray with dark room facilities	1	35	35
Clinical laboratory	1	21	21
Blood storage area	1	11	11
Drug dispensing facility	1	11	11
Stores	3	14	42
Sluice room and janitor closet	1	11	11
Nurses station with toilet	1	18	18
Observation room	1	52	52
Emergency ward	1	14 beds	
Pantry	1	11	11
TOTAL			514

Table 16. Area program of OT complex

Zone A			
OT reception bay	1	11	11
Operation Theatre-in-Charge with toilet	1	18	18
Doctor's changing room	2	14	28
Nurses changing room	2	14	28
Technician change room	1	18	18
Class IV staff change room	1	18	18
Sterile storage area	1	35	35
Instrument and linen room	1	35	35
Trolley bay	1	14	14
Gas cylinder storage	1	11	11
Switch room	1	14	14
Zone B			
Fracture-cum Casualty theatre	1	28	28
Plaster preparation	1	11	11
Splint store	1	11	11
Pre-operative room with toilet	1	28	28
Recovery room	1	11	11
Nurses duty room	1	14	14
Theatre pack preparation room	1	18	18
Frozen section	1	11	11
X-ray with dark room	1	14	14
Pantry	1	11	11
Zone C			
Operation theatres(major)	6	35	210
Operation theatres(minor)	3	28	84
Instrument sterilization	5	11	55
Scrub up	5	11	55
Anaesthetist room	2	14	28
Anaesthetic storage	1	11	11
Aesthesia room	3	21	63
Doctor's work room	2	18	36
Nurses work room	1	18	18
Zone D			
Janitor room	5	10.5	52.5
Soiled utility room	1	10.5	10.5
TOTAL			1010

Table 17. Area program of diagnostic and pathology department

Pathology Department			
Reception and specimen collection	1	42	42
Patient waiting area with toilet	1	42	42
Pathologist laboratory with toilet	4	17	68
Office and record	1	21	21
Technician's room	1	21	21
Stores	4	14	56
Biochemistry	1	42	42
Microbiology with	1	42	42
Media Room	2	14	28
Clinical phytology	2	28	56
Photometry and other equipment	1	14	14
Histology and cytology	1	28	28
Microphotography	1	14	14
Washing and sterilizing area	1	21	21
Serology laboratory	1	21	21
Animal room with washing, weighing & Feeding	1	28	28
Janitor closet	1	3.5	3.5
Specimen disposal	1	10.5	10.5
TOTAL			558.0

Table 18. Area requirements for physiotherapy and rehabilitation unit

Physiotherapy			
Reception with waiting area and toilets	1	21	21
Diathermy	1	10	10
Ultra violet	6	7	42
Infra red	1	10	10
Radiant heat	1	10	10
Traction	1	10	10
Wax bath	1	10	10
Hydro-therapy comprising of a tank, shower & dressing	1	35	35
Gymnasium	1	91	91
Occupational therapy room	1	42	42
Physiotherapist office inc toilet of 3.5 m^2	1	21	21
Store	1	28	28
TOTAL			330

Table 19. Area program of delivery unit

Delivery Suite Unit			
Reception	1	42	42
Examination room with toilet	1	21	21
Doctor's change room	1	10	10
Nurses change room	1	10	10
Class IV change	1	10	10
Technician change room	1	10	10
Sterile storage	1	28	28
Instrument linen	1	10	10
Trolley bay	1	10	10
Switch room	1	10	10

Delivery Suite Unit			
Recovery room	1	35	35
Pack preparation	1	17	17
Anaesthesia room	1	21	21
Delivery room	4	21	84
Operating delivery	1	35	35
Instrument sterilizing	1	17	17
Scrub up	3	10	30
Children birth	1	10	10
Eclampsia room	1	21	21
Dirty utility	1	17	17
Janitors closet	1	7	7
Bank	1	42	42
Post office	1	28	28
Library for patients	1	35	35
TOTAL			560

Table 20. Area program of radiology department

Radiology Department			
Reception	1	14	14
Radiography	2	28	56
Film developing	3	10	30
Film drying room	2	10	20
Contrast studies	2	10	20
Stores	1	14	14
X-ray record room	1	35	35
Radiologists office	2	17	34
Technicians room	1	17	17
Nurses room	1	17	17
Film viewing room	1	14	14
Office	1	17	17
Trolley bay	1	10	10
Switch room	1	21	21
Janitors closet	1	3.5	3.5
TOTAL			322.5
Radio Therapy Unit			
Contact therapy	1	14	14
Superficial therapy	1	14	14
Intermediary therapy	1	14	14
			42
Radiology Department			
Cobalt therapy with dressing cubicle 3.5 m^2 and control room 7 m^2 Room height be 4.5 m^2 including thickness	1	70	70
Mega-voltage therapy (12 mev) with dressing cubicle 3.5 m^2 and control room 7 m^2 and transformer room wherever required. Room height to be 4.5 m including thickness.	1	91	91
Radiotherapists room	1	28	28
Physicist room	1	21	21
Mould room	1	21	21
Simulator room	1	35	35
Treatment planning	1	17	17
CT Scanner control room	1	17	17
Transformer room	1	7	7

Radiology Department			
Dressing room/	1	10	10
Records room	1	42	42
TOTAL			359

3. Data Analysis

Contact space in a hospital building includes the lobby, lift hall, waiting room, waiting area, walkways, business consultancy space and lavatory space. Contact space will allow people to use space collaboratively; the various venues work together to satisfy patient demand for doctor visits. At the hospital, streamline design is very crucial to ensure that people's activities run smoothly and in order. The shortest distance, the shortest amount of time spent turning around, and the least amount of guidance constitute the fundamentals of streamline design. In essence, hospitals are traffic types since they are an important part of studies on the flow of people and daily activities. By using a conversion factor for circulation space, the carpet area of the various services and functions described in the functional programme is used to determine the amount of space needed for the hospital. The area used for circulation will have hallways, stairs, fire escapes, walls, ramps, lifts, etc. The final Area Statement is being given as follows, based on the earlier-prepared area criteria. Table 21 summarizes the total area requirements for various departments in a 100 bedded hospital building.

Table 21. Summary of area requirements for various departments

Final Area Statement		Rationalized Area (m^2)
Room / Zone Name	Area (m^2)	(for Floor Space Analysis)
Administrative Unit	684	660 to 690
Central Sterilization & Supply Dept.	294	300
Dietary Unit	288	300
Laundry Unit	551	540 to 570
Hospital Store	683	660 to 690
Radiology Department	723	720 to 750
Delivery Suite Unit	560	540 to 570
Physiotherapy	330	330
Pathology Department	558	540 to 570
Operation Theatre	1010	900 to 1200
Accident and Emergency Department	514	510 to 540
Pharmacy Department	158	150 to 180
The Blood Bank	176	180
Out Patient Department (OPD)	2147	2100 to 2400
Mortuary Areas	193	180 to 210
Community Services	336	330 to 360
Areas For Maintenance / Workshop	147	150
IPD (Beds in Various Wards)	1848	1800 to 2100
TOTAL (Proposed built up area for 100 bedded hospital)	11200	

From the viewpoint of numerous stakeholders, the planning and design of circulation zones may actually have a substantial impact on users' views and experiences (Jiang & Verderber, 2017). Hospital circulation areas may take up a sizeable portion of a building's total floor space. The Australasian Health Facility Guidelines state that up to 40% of the total functional floor space in general hospitals may be made up of healthcare circulation spaces. The hospital's design should encourage staff productivity, which can be achieved by reducing the transit time between commonly utilised areas and setting up a productive logistics system for food supply. Take into account multi-use areas that cut down on travel time.

4. Results and Discussion

According to current healthcare programming best practises, the departmental grossing factor in a typical 32-bed adult inpatient care unit in the United States can reach up to 1.6, meaning circulation zones may fill up to about 30% of the department gross area. 1 As they connect interdepartmental mobility and communication, these venues are crucial in terms of the 24/7 services and functions they provide. Also, they have a medical purpose because patients who have a certain level

of ambulation use the hallways and nearby public areas for therapeutic activities. Indian Standards (IS 12433, 2006) suggest the area requirements for a hospital buildings as 92.5 Sq.M. per bed (excluding the IPD Area). As per out estimation, area requirements for hospital building is 112.0 m^2 per bed, including the IPD area.

Hospital circulation areas play a critical influence in how all users perceive the overall environment. Researchers found that patients' overall satisfaction levels were closely tied to the public areas in healthcare institutions, and that these areas may potentially have an impact on patients' moods and physical behaviours (Jiang & Verderber, 2017). Health care public spaces should be created to offer a memorable and satisfying user experience by facilitating self-actualization, boosting self-confidence, and advancing general recovery. This particularly applies to hospital employees who spend the majority of their time moving around the hallways dispensing care and obtaining supplies. With an assignment of four patients, a nurse on shift can travel up to five miles in an average 12-hour period; this distance increases dramatically when there are more patients allocated (Chang & Cho, 2022). From the nurse station, nurses and other support staff spend a lot of time looking at the surroundings of the neighbouring corridor and related spaces, which is both necessary and inevitable). Thus, hospital circulation zones could have a big impact on how well nurses and other carers perform at work, are satisfied with their jobs, and feel about themselves.

Yet, healthcare facilities must also take into account clinical needs, comfort, privacy, dignity, environmental requirements, and efficiency in addition to adhering to minimal criteria. By referring to the advice given by the architects and specialists of the medical business, hospitals, mental health, primary care, and community health facilities, as well as (to a certain extent) social care structures, have been able to address these problems for many years. Its guideline established some consistency in design and served as a baseline for best practise, making it a useful resource for healthcare architects, construction and engineering businesses, health planners, doctors, and administrators. However, the healthcare landscape is now changing and this is a competition among leading players of healthcare industry to offer trustworthy superior services at affordable costs.

For the pre-tender stages of a hospital project, researchers (Lorenz et al., 2015) have presented a model to depict the geographical relation out of a given list with adjacencies. The authors have expanded on a straightforward concept that uses rubber bands in some way. Without specifying form, it provides the relation as positions and in the expanded model, their size. We have presented the adjacencies and relationships of various zones in a hospital building with the help of a relationship chart which is crisper. It can be referred by the architects as ready reckoner during their concept and design development stages. On the contrary, other academics think that the fundamental design of a hospital will no longer be defined by its departments. Focus will be placed on the patient's needs and functionality, such as surgical care, infectious illness recovery, conservative oncology, or preventative care (Amato et al., 2022). Functional design will transition from a dispersed pattern of departments to a growing, patient-centric core concept. Best practises for healthcare circulation zone planning and design, as well as their relationship to the health and well-being of their users, must be continuously improved. It has been proposed that single-loaded corridors with windows overlooking the outdoors are intrinsically easier to read than double-loaded corridors with institutional-style interiors and monotonous lighting.

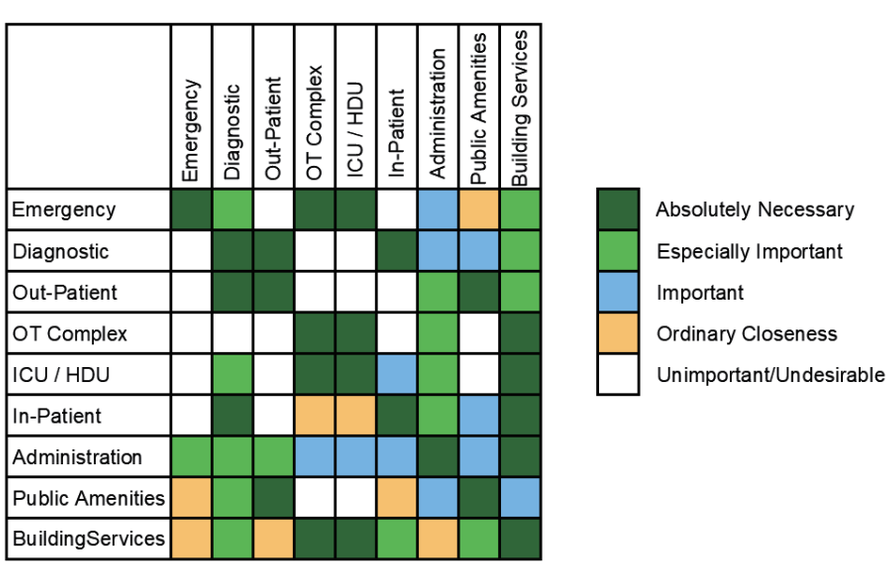

Figure 1. Relationship chart and adjacency matrix of various zones in a hospital building

5. Conclusions

This paper presents the comprehensive study of room wise space requirements for different zones in hospital as per Indian Standards. The area requirements of different zones in hospital are presented in tabular manner which is easy to understand and shall be useful as a ready reckoner for the professionals and students of architecture. Area of different zones is also graphically represented together with the adjacency diagram for clear understanding by the user group. The results of this study will be useful for architectural design and have various advantages, including a decrease in the proportion of human errors and mistakes as well as time and labour savings. The findings of this study will aid in creating a hospital's architectural plan in order to efficiently deliver healthcare services to patients, enhance patient capacity, shorten wait times for medical services, and create a suitable and comfortable environment for both patients and medical personnel.

Further studies can be carried out by the researchers to suggest the configurations / ideal prototype layouts of different zones like OPD, OT Complex etc. while presenting area analysis and various possible arrangements with their pros and cons. To encourage investment in hospital design space and aid the design team in implementing space solutions that improve the sustainability of these structures, it is essential to propose the spatial arrangement in the best possible way. In order to meet complex adjacency/closeness criteria in response to programmatic needs, project site specifications, nearby buildings, as well as environmental considerations like daylight, hospital designs often require systematic design approaches and computational design tools. The complexity of dealing with numerous such performance criteria actually can be reduced by using computational design techniques.

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