# HEALTH FACILITY AND EQUIPMENT PLANNING AND MANAGEMENT

#### Medical Equipment Planning

1. In general, medical equipment planning requires a right understanding of the service and clinical needs; equipment technology; equipment life cycle; budgeting; health facility architectural design; building processes; and the hospital's operational planning, scheduling, and control.

2. The main objective is to ensure the right equipment that fits the right goals is selected, purchased, delivered, and commissioned within the right cost and at a right time.

<b>Basic</b> C	Components of	<b>Medical Ec</b>	quipment	Planning
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Planning	Procurement	Management	
1. Needs assessment	1. Specification preparation	1. Installation	
2. Technology assessment	2. Tender preparation	2. Acceptance	
3. Facility evaluation	3. Tender issuance	3. Commissioning	
4. Budgeting	4. Evaluation	4. User training	
5. Priority setting	5. Tender award	5. Equipment operation	
	6. Equipment delivery		

#### Key Recommendations in Medical Equipment Planning

- 1. In general, the cost of medical equipment is about 20% of the overall project cost in a healthcare facility construction Project.
- 2. Identify, select, and integrate medical equipment with detailed requirements into the architectural and engineering design and planning to prevent changes, delays, quality failures, and cost increases.
- 3. Don't fail in the poor schematic, equipment, and construction planning that can contribute to late or slow delivery, lack of design and construction specifications, change in specifications during construction, and obsolete equipment.
- 4. Initiate medical and non-medical equipment and operational planning at the earliest phase of the overall project initiation in line with the architectural and engineering design in the health facility construction process, and operational plan of the hospital.
- 5. Well-describe the generic equipment specifications and details of the selection criteria in line with the operational plan and the expected hospital service demand and epidemiological plan and forecasts.
- 6. Develop and fully integrate the medical and non-medical equipment procurement and installation plan into the project build plan.
- 7. Clearly show the movement of patients, staff, visitors, and materials/equipment and separate the clean and dirty areas in the hospital configuration/layout.
- 8. Create a timeline for the medical and non-medical equipment procurement that is in line with the project build schedule.
- 9. Ensure all the selected equipment can be effectively installed, placed, and operated within the building design and fit.
- 10. Formulate the master medical and non-medical equipment database and breakdown into a minimum of, individual health facility/hospital departments, services, rooms, and product groups.
- 11. Make a medical and non-medical investment and operational cost analysis and design a reporting process against the agreed budget.
- 12. Develop the procurement plan in line with the identified procurement policies, processes and relevant documentation of the Government of PRC.

## **Budget Management**

3. Clearly design and understand the medical and non-medical equipment budget in line with the equipment planning and procurement strategy.

## **Contingency Sum**

4. Based on the estimated cost escalation factors of the country, create a reasonable contingency of 5%–10% for the new health facility construction and up to 20% for renovation and maintenance. This amount of financial resources is set aside to cover additional costs incurred for unforeseen and/or additional work during the design and construction phases of the Project facilities and procurement and installation of the hospital equipment.

#### Schematic Design

- 1. Translate the project program into physical drawings of space and to present it in a form that achieves client understanding and acceptance.
- 2. Determine the areas, physical requirements, and relationships of all the required building spaces and components including the medical and non-medical equipment.
- 3. Provide spatial and utility requirements to the architect to ensure accurate designs create realistic calculations for the complete equipment budget and develop the project's non-medical and medical equipment plan.

#### **Activities and Deliverables**

- 1. Develop preliminary non-medical and medical equipment and budget
- 2. Coordinate and communicate with the design team including architect, engineers, project manager, construction firm, and information technology (IT)
- 3. Attend user group meetings as required
- 4. Establish medical and non-medical item groupings
- 5. Establish the format for the medical and non-medical item databases
- 6. Develop and synchronize a responsibility matrix
- 7. Undertake horizon scanning and cost estimation for new technologies
- 8. Provide an updated listing of new and existing equipment and define related groupings
- 9. Provide input into the room layout sheets (RLS) design in relation to planned medical and nonmedical equipment
- 10. Develop a preliminary timeline list for procurement and installation of major equipment
- 11. Provide engineering specifications for structurally significant equipment (SSE) to detailed engineering designers, managing contractor (MC), and architects
- 12. Develop the Project equipment procurement, installation, and maintenance plan
- 13. Develop change report process for database medical and non-medical equipment

## **Design Development**

5. Provide all information required to the managing contractor (MC) and associated stakeholders to ensure that it is appropriately coordinated with the architectural build and ensure that the procurement schedule and the associated planning process are moving towards the tender level.

Ac	Activities and Deliverables				
1.	Coordinate and communicate with the	5.	Refine the procurement timeline that is		
	detailed engineering design team		consistent with the project build		
2.	Provide updated equipment specification data	6.	Finalise room by room listing of equipment		
	for all medical equipment to the managing	7.	Provide and review construction,		
	contractor (MC) in an agreed format.		procurement, and installation schedule		

Activities and Deliverables				
3.	Refine and report the equipment list and	8.	Review room data sheets (RDS) and RLS for	
	budget		equipment fit	
4.	Assist with mock-up rooms	9.	Maintain change reports	
		10.	Finalise the procurement programme.	

# Final (Detailed) Design

6. Final design development requires all elements established in the schematic design phase to be considered in greater detail. Important detailed design development features include:

					Medical Equipment
Space Planning			Interior Design		Planning
1.	Operational functionality	1.	Selection and coordination	1.	Types, size, and support
2.	Furniture and Equipment		of finishes (walls, ceilings,		service requirements
3.	Standardization of room		floors) and best taskfit	2.	Portability
	layouts and features in		applications	3.	Operational requirements
	patient rooms for safety	2.	Infection control	4.	Accessibility for servicing
	and efficiency		requirements on finishes		and maintenance
4.	Room data sheet		and material selection	5.	Upgrading and
	development	3.	Fire and smoke ratings of		replacement impact on
5.	Requirements for local		finishes and materials		interior layouts
	customs and practices	4.	Architectural finishes and	6.	Coordination requirements
			fabrics (selection of		for the project construction
			antibacterial materials)		phase
		5.	Signage	7.	Equipment delivery lead
		6.	Provisions for the healing		times
			environment	8.	Contractual responsibilities
					for equipment procurement and installation

7. Medical equipment planning is started in the schematic design phase.

# **Final Design Drawings**

8. The final design drawings development includes schematic design revisions and detailed design solutions typically for:

Site Plans	Building Floor Plans
1. Project phasing	1. Built in joinery
2. Surface materials and landscaping proposals	2. Plumbing fixtures
	3. Major Equipment Layouts and Services
	4. Legends
	5. Room names and numbers
Building Elevations and Sections	Reflected Ceiling Plans
1. Enlargements	<ol> <li>Ceiling systems and fixtures</li> </ol>
2. Façade details	2. Ceiling mounted equipment (lighting, air
<ol><li>Building element details</li></ol>	conditioning diffusers, fire detection and
4. Structural elements	sprinklers, speakers, etc.)
5. Mechanical space	3. Ceiling grid patterns and heights
6. Wall/Floor profiles	Above ceiling services coordination
<ol><li>Interior space configurations</li></ol>	
8. Typical interior wall sections	
9. Raised Floor Areas	

10. Static Free Floors	
Detailed Floor Plan Layouts	Interior Elevations
1. Patient Rooms	1. Joinery and cabinet work
<ol><li>Diagnostic and treatment areas</li></ol>	2. Windows and openings
3. Operating Rooms	3. Surface details
4. Others	<ol><li>Equipment mounting locations</li></ol>
	5. Services locations (plumbing, electrical,
	medical gases, call systems, etc)
Equipment Plans	Life Safety Plans
1. Major medical and diagnostic equipment	1. Firewalls
layouts	2. Smoke barriers
2. Catering	<ol><li>Corridors and emergency exits</li></ol>
<ol><li>Central Plant and HVAC</li></ol>	
4. Laundry	
5. Central Sterilization	
Architectural Services	Engineering Services
1. Master Planning	1. Civil
<ol><li>Feasibility Studies and Project Risk</li></ol>	2. Structural
Management	3. Communications
3. Design Conception	4. Electrical
<ol> <li>Clinical Space – Best Practice Management</li> </ol>	5. Hydraulic
5. Schematic Design	6. Mechanical and HVAC
<ol><li>Design Development and Final Design</li></ol>	7. Medical Gases
7. Engineering Design Services Coordination	8. Security Systems
8. Project Team Management	9. Fire Safety
9. Project Commissioning and Certification Pre	10. Medical Equipment Planning
and Post Occupancy	11. Lift Transportation

9. Health facility and equipment design standards and guidelines should conform to the Chinese and/or international standards and codes.

## **Cost Variables with Hospital Development**

10. Accurate costs can be determined after the architectural, interior design, and engineering drawings and specifications are generated, and equipment and furnishings for the facility and patient care are planned on a room-by-room basis and aggregated and priced. In this sense, the architectural schematics and room lists should be completed to provide the right equipment list and budget. There are other factors that impact capital requirements. Some of them are:

1.	Geological and terrain (including seismic) characteristics that impact excavating and	9.	Incorporation of a hospital information management system (most hospitals now
	foundations costs		incorporate an information system at a typical
2.	Proximity of adequate electrical, natural gas,		cost of \$2 million to \$6 million)
	potable water, sewage lines, telephone and	10.	Incorporation of the picture archiving system
	fiber-optic connections, and roads	11.	The clinical and administrative quality
3.	Parking requirements		assurance system to be employed, for
4.	Staff housing requirements		example, ISO, etc.
5.	Type of construction, for example, reinforced	12.	Taxes
	concrete versus steel and curtain walls	13.	Quality of planning (excellent detailed
6.	Special environmental conditions, for		planning) minimizes costly change orders to
	example, special security provisions and		correct errors or the undertaking of important,
	controls or water diversion to avoid flooding		but unplanned work; change orders
	-		implemented during construction may range

<ol> <li>Choice of surface finishes on floors and</li></ol>	ralls from only 1%–2% of construction costs to
and quality of lighting, doors, and hardwa <li>Clinical services to be provided, for exan</li>	re over 20%)
radiation therapy departments can have	ole,
exceeding \$8 million for equipment along	osts

## Hospital Management Information System (HMIS)

11. Explain the plans for HMIS system procurement, implementation, and maintenance. Describe who will supply and install the system, and provide training to the relevant hospital staff, what kind of package will be procured, cost, supplier's responsibilities, supplier's experience, and track record, installation timetable, the status of negotiations, and who will handle this matter among the members of the project management team.

## **Construction Documentation**

12. Ensure that the equipment schedule and equipment service documents are completed and timeline schedules are confirmed and the room-by-room equipment listing is validated.

Ac	tivities and deliverables:
1.	Coordinate and communicate with the detailed engineering design team
2.	Generate construction documents budget based on the agreed equipment

- 3. Provide updated room-by-room listing of new and existing equipment
- 4. Review construction documents for equipment requirements
- 5. Update and review construction and procurement & installation schedule
- 6. Provide a comprehensive itemized summary of equipment to be procured to managing contractor and relevant stakeholders
- 7. Provide tender level specifications for procurement of selected equipment
- 8. Coordinate early delivery items required for construction
- 9. Develop delivery delay contingency plan.

#### **Risk Analysis**

Prepare a risk management plan that defines how the project team will handle risks to achieve the				
project goals.				
1.	Potential loss of a critical resource	5.	Scope changes	
2.	Technology changes	6.	Project management changes	
3.	Regulatory changes	7.	Budget and legal issues.	
4.	Dependence on a third party			

#### Development of a Schedule of Equipment (SOE)

Develop a Schedule of Equipmen	t (SOE) that shows the following eler	ments:
1. Room reference	5. Item description	9. No of rooms
2. Department	6. Item group (If included	10. Total quantity
3. Sub-department	in the package)	11. Cost per item
4. Room name	7. Item selection	12. Total item cost
	<ol><li>Quantity of items</li></ol>	

## Assess the Need for Equipment

Identify and select the equipment according to the following criteria:

- 1. In line with the project objectives in conjunction with user group input
- 2. Fit for purpose yet user friendly with upgradable life cycle options
- 3. High technology level, allowing each specialist to provide a high quality of care
- 4. High technical standards addressing the current need and future requirements within a departmental area
- 5. Compliant with all relevant standards in the domestic and international level
- 6. Compliant with the sustainability and environmental management and design practices (energy savings, recyclability, and upgradability)
- 7. Easy to maintain

#### **Develop a Services Package**

13. Develop an equipment services package that provides specification information to the construction and architectural teams incorporating all the service information required to install and run the equipment as specified in the project briefs. The equipment planner is responsible for creating and maintaining this package.

To meet the needs of the construction team, the non-medical and medical equipment services package should at a minimum, and contain the following information:

- 1. Item Description: Make, model, and catalogue number
- 2. Architectural: Dimensions and weight
- 3. Electric/ Communications: Power phase, voltage, current, frequency, connection type, power type/ requirement, whether it requires a BMS Connection and data requirements
- 4. Hydraulics: Drainage and water requirements
- 5. Mechanical: Extraction and gases required. Additional information such as the product provider and contact details are also useful.

## The Facility Design and Planning Team

14. Assemble a team of professionals whose knowledge and experience can help ensure that the design and construction plans are realistic and affordable.

The	The planning team will include the following members:					
1.	Chief executive officer or medical planner or medical director (also called director of clinical operations)	5.	Specialty consultants who will cover such areas as biomedical engineering, acoustics, food services, IT systems, and materials			
2.	Project manager (an individual or professional firm with sufficient experience in working with domestic and international clients)	6. 7	management Construction manager Medical equipment planner, who should have			
3.	Architect(s), design engineers, and interior designers		come on board during the project's feasibility analysis stage			
4.	Consultant for the site and geotechnical analysis	8. 9.	Director of nursing Chief financial officer			

#### Space and Functional Programming

- 1. Consider for functional allocation of space in the facility
- 2. Take into account the installation of major medical equipment, communication and IT systems, mechanical and electrical systems, HVAC, and utilities such as gas supply systems
- 3. Take into account each procedure and treatment, as well as each nonmedical service for the comfort and convenience of patients, staff and visitors

- 4. Analyze for logistical and space needs and consider the relationships among the various departments and the pattern of the physical movements of people, equipment, and supplies
- 5. Consider the safety and environmental soundness of the health facility's/hospital's operation, as well as the need for future expansion

## **Conceptual (Preliminary) Design**

- 1. Create initial conceptual drawings of the health facility, working in consultation with the CEO or medical planner, the medical equipment planner, and other members of the planning team.
- 2. Make Schematic Design and Consider Future Expansion.

## Identify and describe the Major Medical Equipment

Ke	ey Selection Factors		
1.	Clinical and Technological Adequacy	7.	Supplies and Spare Parts
2.	Supplier Reliability	8.	Utilities
3.	User Familiarity	9.	Staff Cost
4.	Utilization Analysis and Revenue Estimation	10.	Repair and Maintenance
5.	Life-Cycle Cost Analysis	11.	Financing Cost
6.	Price of Equipment and Cost of Delivery and	12.	Return on Investment Analysis
	Installation		
6.	Price of Equipment and Cost of Delivery and Installation	12.	Return on Investment Analysis

## **Procurement Management and Purchase Contract**

Th	The purchase contract needs to contain most of the following items (in random order):					
1.	Specifications of equipment	11. A timetable that will cover every step				
2.	Terms of delivery (including port of landing if	necessary from the date of signing of the				
	the equipment is imported, responsibility for	agreement until the day that you issue a				
	customs clearance, and local transportation	written confirmation of the acceptance of the				
	between the port and the health facility)	equipment and the installation				
3.	Terms of installation services	12. Prices and fees				
4.	Responsibility for specific actions to be taken	13. Which services will be provided free of charge				
	by the equipment supplier and the buyer	and which will be charged separately?				
5.	Postinstallation testing (Performance	14. Payment terms				
	qualification)	15. Penalty for delays in delivery and installation				
6.	Warranties and indemnities	16. Escrow account conditions				
7.	Insurance	17. Cancellation conditions				
8.	Repairs and maintenance services to be	18. Terms of refund in the event of cancellation				
	provided by the manufacturer	19. Any other terms and conditions applicable to				
9.	Supplies to be provided by the manufacturer,	the Project				
	if applicable					
10	. Training services to be provided by the					
	manufacturer					

15. Ensure that the equipment purchase agreement is made with the equipment manufacturer directly and not with an agent or a broker.

16. Hold a small portion of the payment (about 5%) to the equipment supplier in an escrow account until all work related to delivery and installation is completed satisfactorily. Pay escrow money when the final inspection certification is issued, normally after the installation and test runs of two or three months.

#### Maintenance and Insurance

 It is estimated that a health care facility with well-managed systems usually incurs an annual cost of 5%–6% of the purchase price of the equipment for comprehensive repair and maintenance service.

- Internally managed radiographic and laboratory equipment services cost annually an average 7%– 9% of the equipment purchase price.
- 3. The annual cost of comprehensive service including parts, labor, and software upgrades for complex equipment maintained by the supplier is in the range of 10–15 percent of the equipment purchase price, depending on uptime guarantees.

# **Facility Construction**

17. The following specialists or firms (construction team) are necessary for building a health care facility:

1.	Architect	8. Medical equipment planner	13. Mechanical contractor
2.	Civil engineer	9. Interior designer	14. Signage consultant
3.	Structural engineer	10. Landscape architect	15. Shielding consultant
4.	Mechanical engineer	11. General	16. Food service consultant
5.	Electrical engineer	contractor/construction	17. Surveyor
6.	Medical communications	manager	18. Geotechnical consultant
	planner	12. Electrical contractor	
7.	Medical information system		
	(MIS) planner		

#### **Health Facility Development Process Chart**

1.	Feasibility study	2.	Decision point	3.	Project brief
а.	Demographics	a.	Appoint project manager,	а.	Master plan
b.	Epidemiology		medical planner, architect,	b.	Architectural concepts
с.	Clinical needs		surveyors	C.	Circulation plan
d.	Market analysis	b.	Institute site search and	d.	Clinical services
e.	Competition analysis		acquisition and	e.	Preliminary schematics
f.	Gap analysis		geotechnical studies	f.	Cost projection
g.	Proposed services	C.	Evaluate special		
h.	Licensing requirements		consultants		
i.	Obstacles	d.	Apply for licenses and		
j.	Cost projections		permits		
k.	Projected revenue	e.	Explore financing		
Ι.	Profitability projections				
		5.	Schematic design	6.	Design development
4.	Decision point		phase		phase
а.	Confirm architectural	a.	Structural design	а.	Architects
	engagement	b.	Refine schematic design	b.	Specialized consultants
b.	Engage special consultants (in	C.	Preliminary mechanical,		as required
	structural engineering,		electrical, and plumbing		
	mechanical/electrical/plumbing		design		
	engineering, interior design,	d.	All specialized consultants		
	laboratory design, acoustics		as required		
	engineering, medical				
	equipment planning, laundry				
	and food service, vertical				
	transport, materials				
	management, waste				
	management, central sterile				
	supply room (CSSR),				
	communications, IT, picture				
	archiving and communication				
	system, security and safety				

c.	systems engineers, and value analysis) Confirm financing arrangements				
7.	Contract document phase	8.	Tendering	9.	Bid analysis and comparison
а.	Architects				
b.	Specialized consultants as required				

# **Basic Equipment Specifications Example (Incubator Neonate - WHO):**

1.	Nursing incubator mobile	6. High and low air	13. At least 2 hand ports
	on castors	temperature	<ol><li>At least 2 tubing ports</li></ol>
2.	Temperature control by air	<ol><li>High and low skin</li></ol>	15. Provision for oxygen
	temperature or skin	temperature	supplementation
	temperature	8. Fan failure	16. Provision for humidity
3.	Temperature control range	9. Sensor failure	supplementation
	20°C –37°C	10. Power failure	17. Internal noise < 60 dB(A)
4.	Display of temperature	11. Secondary thermostat	
5.	Alarms	12. Heater power indicator	

# Programming Individual Departments or Services

18. Produce a well-coordinated and efficiently operating health facility.

Step 1					
Review the functions and decide the general policies and procedures for the operation of the service					
area and determine the following requirements:					
<ol> <li>Types of functions for each service area</li> </ol>	3. Which staff member(s) will be responsible for				
2. The processes by which each function will	each function				
be carried out	4. Types of equipment, furniture, and supplies				
	needed to carry out each function				
Step 2					
Determine the rooms or different work areas that ar	re needed and focus on:				
1. Technique	4. Personnel responsible for each function				
2. Volume of work	5. Types of certain equipment serving more than				
3. Best work flow	one function				
Step 3					
Determine the relationships between departments a	and services and focus on logical traffic and				
workflow.					
Step 4					
Determine the design criteria for each room or area					
<ol> <li>List the functions to be carried out in the</li> </ol>	5. Determine the equipment for each				
room.	workstation. The listing of equipment required				
2. Study activities and determine workstations.	at each workstation should include:				
3. Determine the activities or subdivisions of	a. Fixed equipment (work counters,				
work that are necessary to accomplish each	cabinets, sinks, other stationary				
function that is to be carried out in the room.	equipment);				
4. Decide which of these activities can be	b. Mobile equipment (ex: portable ultrasound				
handled at the same workstation and which	machine).				
will require separate workstations.	6. Decide on the ceiling and floor design in line				
	with the equipment shape and functionality.				
	7. Decide on working relationships within the				
	room. Use work flow charts.				

Ste	Step 5				
Det	ermine other special requireme	ents	and items for the room.		
1.	Special plumbing	5.	Pressure requirements (for	9. Electrical outlets	
	requirements		instance, for pressurized	10. Ventilation	
2.	Oxygen outlets		rooms)	11. Communications	
3.	Vacuum outlets	6.	Gas outlets	12. Finishes	
4.	Compressed air outlets	7.	Waste gas evacuation	13. Entry and exit requirements	
			system	14. Special design	
		8.	Special lighting	requirements	

19. It is important to note where special features in equipment are necessary for proper work conditions. Here is a partial list of suggested services to be considered in the functional program:

1.	Administrative: lobby, administrative offices, business and accounting facilities, personnel department, admitting, switchboard, reception	<ol> <li>Nursing and medical services: utility room, exam rooms, diagnostic and treatment rooms, specialized medical procedure rooms</li> <li>Educational services: education for patients</li> </ol>
2.	Support services: communications, supplies, stores, laundry, plant engineering and maintenance, housekeeping, materials management, dietary, central services	<ul><li>and their families; in-service staff training and continuing education and staff meetings</li><li>6. Miscellaneous services and auxiliary functions: gift shop, conference rooms,</li></ul>
3.	Specialized services: pharmacy, medication distribution, medical records, social services, spiritual services	libraries, cafeteria

20. Here is a list of suggested systems to be considered:

Мес	Mechanical, plumbing, and electrical systems (Alternative 1)					
1.	Chilled water distribution	11. Distribution systems including main				
2.	Heating/hot water distribution	switchgear, subpanels, and disconnects				
3.	Steam distribution	12. Emergency service and evaluation of				
4.	Air distribution (HVAC) and clean rooms	existing loads and capacity for future				
5.	Domestic water systems (hot and cold)	expansions/renovations				
6.	Infection control and positive/negative	13. Fire alarm system				
	pressure rooms	14. Call systems				
7.	Medical gas systems: pumps, compressors,	15. Elevators				
	and so forth	16. Security				
8.	Fire protection systems	17. Existing code-related deficiencies for the				
9.	Plumbing systems: fixtures, valves,	intended use of the facility				
	hardware, and so forth	18. Estimate of remaining useful life and costs				
10.	Main electrical service and evaluation of	to replace/repair equipment				
	existing loads and capacity for future					
	expansions/renovations					
Ess	ential Engineering (MEP) Services and Equip	oment (Alternative 2)				
1.	Electrical HV/LV Mains and Switchgear	11. Building Management System-(hospitals and				
2.	Emergency Power Plant	surgical facilities)				
3.	UPS	12. Fire Safety and Security Systems- includes				
4.	Emergency Lighting Systems	CCTV and Access Control Systems				
5.	Communication networks, including PABX	13. Medical Gas Systems				
6.	Call Systems- includes Emergency, Nurse,	<ol><li>14. Imaging and Diagnostic Equipment</li></ol>				
	Public Address, Duress and Paging	15. Sterilization and Decontamination Equipment				
7.	Vertical Transportation Systems	<ol><li>Mains Water and Treatment plant</li></ol>				
8.	Pneumatic Tube Carrier System	17. Domestic Hot Water System				
9.	Critical Central Plant	<ol><li>Patient Isolation Room HVAC Systems</li></ol>				
10.	HVAC Systems					

Ме	Medical communications systems					
1.	Telephone system (including wireless)	11. Intercom				
2.	Hospital information system (HIS)	12. Radio (two-way and ambulance)				
3.	Voice and data infrastructure	13. Dictation and transcription				
4.	Telemedicine, teleradiology, and picture	14. Cable/satellite television				
	archiving and communicating system (PACs)	15. Videoconferencing				
	(network infrastructure)	16. Education and entertainment video				
5.	Patient monitoring and telemetry (network	distribution				
	infrastructure)	17. Audio/video presentation				
6.	Nurse call/code blue	18. Closed circuit television				
7.	Pocket paging	19. Security				
8.	Staff/patient/visitor equipment location	20. Door access control				
9.	Public address	21. Infant abduction control				
10.	Theater/auditorium sound					

#### Medical equipment

1.	Imaging equipment and systems	5.	Sterilization and decontamination equipment
2.	Telemetry and patient monitoring	6.	Laboratory equipment
3.	Patient room furnishings	7.	Others
4.	Equipment management columns (booms)		

# **Criteria for Selection of Medical Equipment**

Key criteria include:

1. Efficacy and effectiveness	4. Reliability	8. Service
2. Performance	5. Features	9. Training
3. Safety	6. Ease of use	10. Continued user support
-	7. Cost-effectiveness	

21. **Efficacy** is the ability of a diagnostic or therapeutic modality to fulfill its intended clinical purpose under optimum conditions.

22. **Effectiveness** is the ability of a modality to fulfill its intended clinical purpose under realworld conditions and in day-to-day practice. Performance is the measure of the ability of equipment to fulfill its intended purpose in conformity with its technical specifications or a standard.

23. **Safety** is a systems concept, not simply a product attribute.

24. **Reliability** is the measure of consistent performance and safety without failure.

25. **Features** are standard functional characteristics that define a type of device plus unique characteristics that differentiate it from other brands and models of its general type and purpose.

26. **Ease of use** reflects human factors design (ergonomics), user-friendliness of software, clarity of instructions, and intuitive operation by the user.

27. **Cost-effectiveness** refers to the measure of health benefits for a given cost. Cost per use is usually more significant than initial purchase price.

28. **Effective service** has four components: documentation, parts, competent and responsive personnel, and health facility support.

29. **Training** has two main objectives: to enable clinical users to apply the device safely and effectively to patients to achieve clinical objectives, and to enable engineering personnel to inspect, maintain, and service the device.

30. **Continued user support** includes provision of documentation, replacement parts, software upgrades, and technical guidance to support continuing safe and effective device operation, as well as service and maintenance of the equipment.

## Universal Design

31. Focus on universal design concept in the health facilities. It is the design of products, environments, programmes, and services to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design.

Un	Universal Design in Healthcare Facilities						
1.	Promotes medical facility policy-making that	6.	Promotes an improvement in the health of				
	considers the needs of everyone who uses		clients and personnel.				
	the facility: clients and their families, service	7.	Offers solutions that can be modified or				
	providers, and distributors.		changed to meet different users' needs and				
2.	Promotes resource savings.		requirements.				
3.	Reduces potential risks and promotes a safe	8.	Helps balance the needs of different people.				
	environment.	9.	Reduces professional burnout of medical				
4.	Acknowledges human diversity.		personnel.				
5.	Makes service provision human-centred,	10.	Optimises efforts and facilitates the work of				
	ensuring safety, high quality, and respect for		personnel.				
	human dignity.	11.	Improves the safety and comfort of all.				

#### The Benefits of Universal Design

Creates an inclusive society which acknowledges human diversity, ensures equality and social inclusion on equal terms, and promotes respect for the abilities of every person.

- 1. Improves the quality of life of all people, leaving no one behind.
- 2. Reduces stigma and discrimination, providing more opportunities for vulnerable groups.
- 3. Promotes independence, mobility, and social inclusion.
- 4. Reduces the economic burden of special programmes and services which aim to assist specific persons and groups.
- 5. Acknowledges the needs of all users in different fields and thus prevents irrational future expenses for businesses and governments.
- 6. Makes the world attractive, comfortable, accessible, convenient, and safe for all users.

# **Circular Architecture and Performance-based Design in Health Facilities**

32. Consider that hospitals produce 13 kg waste per bed per day. In general, 85% of the waste generated by healthcare activities are non-hazardous waste. The remaining 15% is considered hazardous material that may be infectious, toxic or radioactive. The world's healthcare systems produce 4% of global  $CO_2$  emissions. In this context:

- 1. Develop and implement a health facility waste management programme in line with the green circular economy concept of the ADB.
- 2. Focus on the structural, technical, and spatial characteristics of modular spaces in the event of a future change of use in the design of the health facilities.

- Optimize material and energy flows in line with the fundamental principle of the green circular economy throughout the project, especially in the choice of materials, the design of prefab building envelopes, or in energy conservation practices.
- 4. Combine optimised functionality (reduced distances) and high flexibility (modular surfaces).
- 5. Maximize natural light to create an ideal environment for patients, visitors and staff.

#### Hospitals and Clinics (Example)

33. Define the services and clinics in the health facility (plan and describe the necessary medical and non-medical equipment accordingly) as given below:

General Hospital					
1.	Endocrinology	4.	General Surgery	7.	Plastic surgery
2.	Psychiatry	5.	Internal diseases	8.	Medical Genetics
3.	Gastroenterology	6.	Eye diseases	9.	Ear Nose Throat
			(Ophthalmology)		
Ca	rdiovascular Hospital				
1.	Cardiology	3.	Pediatric Cardiovascular	5.	Immunology and Allergy
2.	Cardiovascular surgery		Surgery		Diseases
		4.	Chest Diseases	6.	Thoracic Surgery
Ne	urology - Orthopedics Hospit	tal			
1.	Brain surgeon	3.	Infectious Diseases and	4.	Neurology
2.	Dermatology		Clinical Microbiology	5.	Orthopedics
On	cology Hospital				
1.	Algology	5.	Nephrology	9.	Surgical Oncology
2.	Gastroenterology Surgery	6.	Radiation oncology	10.	Medical Oncology
3.	Geriatrics	7.	Family Medicine	11.	Urology
4.	Hematology	8.	Rheumatology	12.	Health Council
Ch	ildren's Hospital				
1.	Child Emergency	13.	Child Developmental	25.	Child Palliative Care Center
2.	Child Adolsan (Adolescent		Pediatrics	26.	Child Psychiatry (Child and
	Health)	14.	Child Genetics		Adolescent and Mental
3.	Pediatric Neurosurgery	15.	Pediatric Chest Diseases		Health)
4.	Pediatric Surgery	16.	Child Eye	27.	Pediatric Radiology
5.	Child Solver (Health Board)	17.	Pediatric Hematology and	28.	Pediatric Rheumatology
6.	Child Dental		Oncology	29.	Child Healthy Child
7.	Child Breastfeeding -	18.	Pediatric Immunology and	30.	Child Health and Diseases
	Relactation and Maternal		Allergy Diseases		(General Pediatrics)
	Support	19.	Pediatric Cardiovascular	31.	Pediatric Urology
8.	Pediatric Endocrinology		Surgery	32.	Child Newborn
9.	Child Infection	20.	Pediatric Cardiology		(Neonatology)
10.	Child Home Health Unit	21.	Pediatric Metabolic	33.	Pediatric Intensive Care
11.	Child Physical Therapy and		Diseases		
	Rehabilitation	22.	Pediatric Nephrology		
12.	Pediatric Gastroenterology	23.	Child Neurology		
		24.	Children's Orthopedics		
Maternity hospital					
1.	Gynecology Emergency	7.	Infertility	12.	Polycystic Ovary Syndrome
	Service	8.	Gynecology (Gynecology 1)	13.	Birth in water
2.	Family planning	9.	Gynecology (Gynecology 2)	14.	Recurrent Pregnancy Loss
3.	Sexual Health	10.	Chronic Pelvic Pain and	15.	Gynecological Oncology
4.	Delivery Room-Antenatal		Endometriosis Outpatient		Surgery
	(Normal Pregnancy Service		Clinic	16.	Perinatology (High Risk
	and Polyclinic)	11.	Menopause		Pregnancies)
5.	Pregnant School			17.	Newborn Service

6.	IVF (In Vitro Fertilization)				
Physical Therapy and Rehabilitation Hospital					
1.	Brain Injury and Stroke Rehabilitation	11.	Rheumatological Rehabilitation	21.	Upper Extremity and Hand Rehabilitation Laboratory
2.	Pediatric Rehabilitation Clinic	12.	Athlete Health Rehabilitation Laboratory	22.	Oncological Rehabilitation and Lymphedema
3.	Subacute Rehabilitation	13.	Subacute Rehabilitation		Laboratory
4.	Clinic - Foreign Patient Clinic Rheumatology, Orthopedics	14.	Non-Invasive Brain Stimulation (NIBS) Electromyography (EMG)	23.	Cognitive and Communication Skills Laboratory
	Rehabilitation and Pain Clinic	15.	Laboratory Gait and Posture Analysis	24.	Neurogenic Swallowing Laboratory
5.	Spinal Cord Injury Rehabilitation Clinic	16.	Laboratory Sarcopenia, Osteoporosis	25.	Cardiac and Pulmonary Rehabilitation Laboratory
6.	Brain Injury Rehabilitation Clinic	17.	and Obesity Laboratory Urodynamics Laboratory	26.	Sitting Clinic-Wheelchair and Support Devices
7.	Traditional and Complementary Medicine (Getat)	18.	Electrotherapy, Mechanotherapy and Manual Therapy	27. 28.	Laboratory Group Workout Gym Vision Rehabilitation
8.	Neuromuscular Damage Rehabilitation	19.	Robotic Rehabilitation and Assisted Walking Device	29.	Laboratory Interventional Pain
9.	Spinal Cord Injury		Laboratories		Laboratory
10	Rehabilitation	20.	Hydrotherapy and		
10.	Pediatric Renabilitation		Aquatherapy (Pool		
Hio	h Security Forensic Psychia	tric k			
1	Forensic Medicine		lospital		
Cli	nical Research Centre				
1.	Phase-1, Bioavailability/bioequ	uivale	ence studies		
Ма	in Mass				
1.	Emergency Medicine Clinic	4.	Tissue Typing Laboratory	7.	Medical Biochemistry Clinic
2.	Family Medicine	5.	Nuclear Medicine Clinic	8.	Medical Microbiology Clinic
3.	Anesthesia and	6.	Radiology Clinic	9.	Medical Pathology Clinic
_	Reanimation Clinic				
Fea	atured Services	4.0		~~	
1.	Mother Friendly Hospital	16.	Pregnant School	29.	Retinopathy of Prematurity
2. 2	Baby Friendly Hospital	17.	Complementary Medicine		(ROP) Diagnosis, Treatment
J. ⊿	Child Dialysis		(Getat)	30	Robotic Rebabilitation
5.	Pediatric Bone Marrow	18.	Genetic Diseases Diagnosis	00.	Devices
	Center		Center	31.	Sarcopenia / Muscle Loss
6.	Child Palliative Care Center	19.	Eye Bank		Polyclinic
7.	Pediatric Therapeutic	20.	Huntington's Disease	32.	Smoking Cessation Unit
	Apheresis Center		Outpatient Clinic	33.	Respiratory Rehabilitation
8.	Pediatric Burn Treatment Center	21.	Advanced Parkinson's Disease	34.	Unit Athlete Health Rehabilitation
9.	Dementia Outpatient Clinics	22.	Stroke Center and Units		Laboratory
10.	Adult Dialysis	23.		35.	Birth in Water
11.	Adult Bone Marrow Center	24.	Cardiopulmonary	30.	Medical Genetics Polyclinic
1∠.   1२	Adult Therapeutic Apheresis	25	CBRN (Chemical biological	57.	Nutritional)   Init
13.	Center	20.	radiological and nuclear)	38	Sleep Labs
14.	Adult Burn Treatment		Decontamination Unit	39	ART (Assisted Reproductive
	Center	26.	Chemotherapy Unit	201	Technology) Center
15.	Home Health Care			40.	Intensive Care

		27. 28.	Oncology Diagnosis Treatment Center Organ Donation and Transplant Center		
l m f	emotional Dationts (Ilealth T				
	VIP rooms	ouris			
Ge	neral Support Facilities				
1. 2. 3.	Sterile Processing Linen Services Materials Management	4. 5.	Waste Management Environmental Services	6. 7.	Engineering and Maintenance Services Morque Services
Bu	ilding Systems				
1. 2. 3. 4.	General Hospital Elevators Heating, Ventilation, and Air-Conditioning Systems (HVAC Systems +HEPA Filters + Clean Rooms, etc) Electrical Systems (essential electrical systems, paralleling Emergency Generators, UPS, etc.)	5. 6. 7. 8.	Water and Plumbing Systems (water systems, drains, bathrooms, Legionella prevention, etc) Communications Systems Electronic Safety and Security Systems RFID (Radio Frequency Identification) System	9. 10. 11.	Medical gas systems Steam Generators (heating, laundry, kitchen, steam, sterilization, etc.) Other Special Systems
Patient Support Facilities					
1.	Laboratory Services	2.	Pharmacy Services	3.	Food and Nutrition Services
Outdoor Parking Lots					
<ol> <li>Emergency Medicine outdoor parking lots</li> <li>Other outdoor parking lots</li> </ol>					
Fire Protection					
Conference Halls and Training Rooms					

## Facility Construction as Planned, on Time, and on Budget

34. Health facility construction projects are very complex and present numerous challenges. The main success criteria depend on the cost, time and quality of implementation in line with the current national and international health facility/healthcare regulations and standards.

35. A well-experienced contractor and a Project manager with sufficient capabilities, knowledge and experience in the health facility planning, design, construction and operationalization are essential drivers to manage all aspects of the health facility Project as planned, on time and on budget.

36. The Schematic Design Phase will result in architectural and engineering designs which are based on rigorous analysis through simulation of the service demand, processes, staffing, equipment, technology and building layout. Models of care can be further tested and refined in the Schematic Design Phase. This enables the cost estimate, program and business care to be finalized to a limit of cost budget and commitment to proceed with contract documentation and construction.

37. Focus to develop and integrate specifications of the major medical equipment into the health facility design and construction planning. Well-timed and well-coordinated management of the selection, procurement, and installation processes will be critical to successful completion of the health facility's construction on schedule and within budget. In this context:

- 1. Select the right equipment for the health facility
- 2. Set a realistic timetable for procurement
- 3. Pay attention to the terms and conditions of the purchase contract and related matters
- 4. Make meticulous preparations for delivery and installation
- 5. Ensure adequate training for personnel who will use the equipment

38. Ensure that health facility design and building construction program includes the following risk mitigation management controls:

- 1. Infection Control Risk Assessment
- 2. Environmental Impact Assessment
- 3. Health Risk Assessment

39. Ensure that the following events are completed and/or occurring before starting the construction stage:

- 1. The outcome of the feasibility analysis has confirmed the project's physical, operational, environmental, and financial viability.
- 2. A construction site of the size and character required for your hospital has been secured. If applicable, fences around the border of the land would have been installed as well.
- 3. A construction manager (preferably a company, not an individual) has been identified and retained.
- 4. The final versions of the design concept and schematic drawings described and approved after full discussion with the core team.
- 5. Detailed cost estimates have been reviewed and discussed fully and a consensus has been reached.
- 6. Firm, written commitments of financing have been obtained from the financial partners and cover at least 80%–90% of the total amount of estimated funding needed, including the amount for contingency.
- 7. At least 50% of total cash spending needed in the next 12–18 months is available in cash in a bank account, excluding the amount of soft costs that have already been spent.

## Hospital and Health Care Construction Pitfalls

1.	Poor initial strategic planning assumptions	10. Lack of knowledge about the current codes
	very rapidly)	11. Infighting among the key parties involved
2.	Poor experience and knowledge of the	12. Inappropriate "cost segregation" resulting in
	contractor and/or Project manager	inappropriate depreciation and excessive
3.	No real facility master plan done	taxes
4.	Unsubstantiated or nonexistent space	13. Renting rather than buying equipment when
	program (hence a facility that is overbuilt)	renting does not make financial sense
5.	No one really in charge of the project (who	14. Exposure to litigation (quite common)
	has time and the right expertise)	15. Too many expensive change orders
6.	The wrong person or firm assumes control of	16. Duplicate fees
	the project	17. Excessive fees (per consulting group)
7.	Gaps in expertise	18. Cost overruns that cannot be financed
8.	Poor-quality work by consultants	
9.	Inadequate or poorly coordinated contract	
	documents	

40. Careful and comprehensive planning and well-coordinated execution of the plans are the best way to ensure the successful completion of a health facility's construction.