



Process of Planning a Tertiary Care Hospital and Suggestions to the Challenges prevailing

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Abstract: India is a developing country and the current situation of the healthcare delivery system is not up to the mark. The study deals with the stepwise process of initiating and planning a tertiary care hospital. An attempt has been made to identify the processes, sub-processes, methods of calculation, tools to be used, standards to be referred, and stakeholders responsible behind each of the steps. To make the deliverables and responsibility of each stakeholder clear, a RACI matrix has been generated for both government and private hospital projects. But the infrastructure alone is not sufficient to solve the challenges prevailing therefore the challenges prevailing had been identified and suggestions have been given for improving the situation. A survey was also conducted to understand the challenges and to know the quality of services provided. The most unsatisfied facility in public, as well as private, was found out and a method to rectify it in the planning stage itself has been suggested.

Index Terms – Tertiary care Hospital, planning process, stakeholders, and challenges prevailing.

1 INTRODUCTION

Hospitals are the most complex of building type. Each hospital is comprised of a wide range clinical laboratories, imaging, emergency rooms, and surgery; hospitality functions, such as food service and housekeeping; and the fundamental inpatient care or bed-related function (FACILITY MANAGEMENT). This diversity is reflected in the breadth and specificity of regulations, codes, and oversight that govern hospital construction and operations.

In India there is a huge difference in terms of services provided by a government hospital and a private hospital. The Healthcare demand of the population in India is increasing at an alarming rate. To cater this demand of the population, the healthcare industry in India is growing day by day, there are many government schemes which are working towards fulfilling the demand of the increasing the number of a healthcare facility and trying to improve the quality of service given to the patients. Many private healthcare facilities are working on the same agenda by keeping their profitability in mind. It is thus very important to plan a healthcare facility in a way that maintains the balance between the two and delivers the product which is beneficial for patients as well as the healthcare service provider.

2 APPROACH TO TERTIARY CARE HOSPITAL

Hospitals are broadly classified into primary, secondary and tertiary care hospitals based on specialisation and approachability to the people. Primary care are situated in the village or locality level with the availability of one physician only. Secondary care caters to the patients referred by the primary care **who required the expertise or procedures performed under specialists**, and are situated at local community level These include ambulatory care and **inpatient services, emergency rooms, intensive care medicines, surgery services, physical therapy, labor and delivery, endoscopy units, diagnostic laboratory and medical**

imaging services, hospice centers, etc. Some primary care providers may also take care of **hospitalized patients and deliver babies** in a secondary care setting. **Tertiary care caters to patient referred from primary as well as secondary care are hospital or regional centers equipped with diagnostic and treatment facilities not generally available at local hospitals.** They include **trauma centers, burn treatment centers, advanced neonatology unit services, organ transplant, radiation, oncology, etc.**

Hospitals are also classified under IPHS (Indian Public Health Standard) as Primary, Community, Sub district and District hospitals. All these hospitals should follow the expected requirements mentions in (IPHS, 2012).

Therefore there are 2 ways to approach to a tertiary care hospital

1. Converting a secondary care hospital to a tertiary care hospital by adding facilities and new building blocks by fulfilling the expected and desirable requirements of a tertiary care hospital. As mentioned in (IPHS, 2012). While the tertiary care units are being installed in or around the building, the hospital can still be served as a secondary care hospital.
2. Planning for a tertiary care hospital altogether from the scratch. This will also include expected and desirable requirements of a tertiary care hospital. That means the hospital can't function until the whole building has been built and all the equipment and necessary labs have been installed.

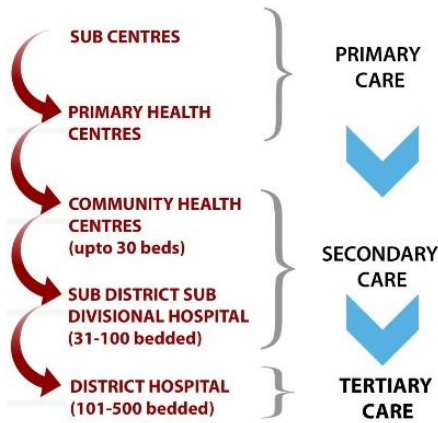


Figure 1: flowchart showing referral system of healthcare facilities in India and approach to a tertiary care hospital

3 PLANNING PROCESS OF A TERTIARY CARE HOSPITAL

As discussed above the planning for a tertiary care hospital can be done in two ways

1. Extending a secondary care hospital
2. Making a tertiary care hospital altogether.

The planning process involved in each of the case are similar but the requirements changes according to the need of the client or the hospital administration. For example: for extending a secondary care hospital that was originally serving as general medicine, gynaecology and orthopaedic and emergency departments is later adding to a trauma centre to make it a tertiary care multispecialty hospital has to just take care of trauma centre at a time. But if it is planned to be a tertiary care hospital there will be too many specialities to be catered under one roof, the services and functionality need to be planned very well in advance within the project brief itself.

Planning of a hospital seldom receives the right amount of attention it deserves. A large sum of money is involved for the construction of healthcare building and the end user being sick patients it is very important to plan it in such way that it caters to the future availability of funds.

3.1 Project Inception

This step is followed government to prepare the schemes that would help in shaping the hospitals well and available for all.

Project inception can be defined as a starting of a concept stage of a project (Per Kroll, 2003). The purpose in this phase is to achieve concurrence among all stakeholders on the lifecycle objectives for the project. The four most important objective of the inception phase are:

1. **The clarification on vision of the project:** the vision of the project gives a clear understanding on what are the problems we are catering to. Usually vision of a hospital caters to the goal set by a government scheme or the owner itself.
2. **Identification of the desired system:** the key system has to meet all the requirement of the catchment area , so it is important to conduct a survey of what all is available in the catchment area and what will be the key requirement of the proposed project
3. **Find out at least one possible solution:** analysing whether the vision set is feasible or not in the current location and system.

4. Understanding the estimate of costs, schedule and risks associated with the project

3.1.1 Health policies: Goals and options

There are various schemes and policies proposed by the government which works towards delivering an efficient healthcare services all over the country. One such scheme is *pradhan mantri swasthya suraksha yojna (PMSSY)*, which falls under the ministry of health and family welfare. This works on a national level. Through this scheme the government is focusing towards the provision of AIIMS in every state. Likewise, it is important to have a certain vision for any of the schemes or policy before being started as rational planning for health facilities requires rational planning for health services, since the facilities exists only to support these services to be provided. The policies will only be successful if the services are equally available to the population and each hospital's requirement is fulfilled by trained staffs and supplies.

Any government scheme or policy is it national level or state level undergoes:

1. Primary statistical studies with the help of the reports and understand the risks due to DALYs. (Welfare, 2017) . India relies on *Public Health Foundation of India (PHFI)*, which works in collaboration with ICMR, MOHFW and IHME and yearly update of *National Health Policy by MOHFW* for the calculation and statistical data for its burden of disease profile, mortality rate, DALYs, YLDs, and risk factors contributing to each one of them.
2. Then one assesses the cost effectiveness of the health interventions which can address these causes of loss in DALYs. In a conventional cost effective analysis, the economic cost of an intervention is divided by an estimate of its health effects (Micheal Hopkinson, 1996).
3. The most cost effective interventions are packaged in the best way for their efficient and effective delivery. These packages include promoted, preventive and curative services and the first referral mechanism.

3.1.2 Defining Health Infrastructure

In order to give a safe and suitable physical environment to the patient and staff apart from the availability of drugs and consumables, there is a need to identify a proper infrastructure that would improve the quality and efficiency of the services. Building influences the extent and quality of services which can be provided just as much as fixing their location. Depending on what has to be delivered and the catchment area, the type and the kind of the institution have to be decided as it influences the activities which can be accomplished in the premises. Based on the need and type of institution, (Dibyendu Ghosh, 2017) a considerable amount of resources are invested in the construction so that the infrastructure established provides an appropriate basis for promoted, preventive and curative interventions.

3.1.3 Overview of what is available

It is very important to address what is already available to cater to the BOD in the catchment area. When discussing investment programmes for upgrading and building new facilities, it is difficult for the Ministries and donors to set reasonable priorities. Most of the promoters does not have enough knowledge about the existing condition and the effect it will have on a macro level in future that will increase the quality of the building and also on the future recurrent expenditure.

Therefore, it is important for a health ministry to have a detailed inventory of the country's health policy. The information required may only include

- Name of the Institution
- Location
- Catchment population
- Date of construction
- Departments its catering to
- Date of most recent refurbishment
- Number of beds, if possible in different categories, (male, female, maternity, paediatrics)
- Number of OPD consultation room
- Number of major and minor OTs
- Number of staff in different categories
- Electricity and fuel readings.

These data are usually obtained by surveys from patients of the existing conditions. These observations provide a basis for discussing and setting the priorities within a project.

3.1.4 Capital investment policies and recurrent cost implication

After investing into the construction of a healthcare building it is equally important to calculate the annual running cost of the building as well. The recurrent costs or the running costs could be estimated 2 major categories, **HR costs** which includes the salaries of staffs, medical support, Site services Administration and Clerical and **G&S cost** which includes Goods and services costs such as domestic supplies and services, Drugs, Equipment leasing, food supplies and other utilities (IPHS, 2012).

The implication which the project has to face with the recurrent cost has to meet the goal and objective perceived at the very beginning of the project. For a Government project, the implication could be the availability of funds from the government, whereas in private project it would be the profitability in the business model.

3.1.5 Perceived causes and goals

When an institution fails to perform according to the perceived cause and goal due to its inefficiency and poor quality, it is not usually possible to solve the problem by capital investment alone (Micheal Hopkinson, 1996). If there is a problem is in the procedural management and supply of the service then it would not be solved by improving the infrastructure of the facility.

This is not always the case as in case where some wards have a high occupancy rate and always overcrowded, then one of the solution can be the construction of new wards, but before taking this decision, it is important to investigate the reason of overcrowding, length of the over stay of patients may be because of the poor staff procedure, unhygienic conditions, unavailable or non-functioning equipment, shortage of pharmaceuticals. Another reason of the failure could be the preventive programme has failed. So it would be an economical and feasible option to improve the condition of the existing ward rather than building a new ward altogether.

3.2 Site Selection

There are various factors that should be kept in mind before selecting a site for a hospital. CPWD manual 2019 is referred to through lights on some of the necessary factors for selecting a site.

(CPWD, 2019)

3.2.1 Area and Space Norms of the Hospital

- Minimum Land area requirement are as follows:
- Up to 100 beds = 0.25 to 0.5 hectare
- Up to 101 to 200 beds = 0.5 hectare to 1 hectare

- 500 beds and above = 6.5 hectare (4.5 hectare for hospital and 2 hectare for residential)
- Size of hospital as per number of Beds

General Hospital - 80 to 85 sq. M per bed to calculate total plinth area.

The area will include the service areas such as waiting space, entrance hall, registration counter etc. In addition, Hospital Service buildings like Generators, Manifold Rooms, Boilers, Laundry, Kitchen and essential staff residences are required in the Hospital premises.

In case of specific requirement of a hospital, flexibility in altering the area is kept.

Teaching Hospital - 100 to 110 sq. per bed to calculate total plinth area.

3.2.2 Site Selection Criteria

In the case of either site selection or evaluation of adaptability, the following items must be considered: Physical description of the area which should include bearings, boundaries, topography, surface area, land used in adjoining areas, drainage, soil conditions, limitation of the site that would affect planning, maps of vicinity and landmarks or centers, existing utilities, nearest city, port, airport, railway station, major bus stand, rain fall and data on weather and climate.

3.2.3 Factors to be considered in locating a district hospital

- The location may be near the residential area.
- Too old building may be demolished and new construction done in its place.
- It should be free from dangers of flooding; it must not, therefore, be sited at the lowest point of the district.
- It should be in an area free of pollution of any kind including air, noise, and water and land pollution.
- It must be serviced by public utilities: water, sewage and storm-water disposal, electricity and telephone. In areas where such utilities are not available, substitutes must be found, such as a deep well for water, generators for electricity and radio communication for telephone.
- Necessary environmental clearance will be taken

3.2.4 Site planning strategy

(UNITED, 2014) A rational, step-by-step process of site selection occurs only in ideal circumstances. In some cases, the availability of a site outweighs other rational reasons for its selection, and planners and architects are confronted with the job of assessing whether a piece of land is suitable for building a hospital.

In the already existing structures of a district hospital

- It should be examined whether they fit into the design of the recommended structure and if the existing parts can be converted into functional spaces to fit in to the recommended standards.
- If the existing structures are too old to become part of the new hospital, could they be converted to a motor pool, laundry, store or workshop or for any other use of the district hospital?
- If they are too old and dilapidated then they must be demolished. And new construction should be put in place

Hospital Building – Planning and Lay out Hospital Management Policy should emphasize on hospital buildings with earthquake proof, flood proof and fire protection features. Infrastructure should be eco-friendly and disabled (physically and visually handicapped) friendly. Local agency Guidelines and Bylaws should strictly be followed.

3.2.5 Future expansion scope

One should never over purchase unless there are defined plans for future expansion. Future expansion scope is set by the clients and majorly depends on the flow of income generated by the first phase of the construction. In case there is over purchasing of land the safety of the patients becomes at stake as the property becomes difficult to manage. However, Geographic Constraints are rarely the only consideration when it comes to facility location, other important factors are,

3.2.6 Considering patient friendly environment

The catchment area should be selected in a smart and futuristic manner. The site should have a patient friendly environment; if the natural condition of the site is not fulfilling the need then the design should comply with the “guidelines and Space standards for barrier free environment for disabled and elderly persons “of CPWD/ Ministry of Social welfare, GOI

3.2.7 Proximity to other healthcare access points

In case a patients visits to the hospitals and fails to get the service he/she needs, then the location of the hospitals should be such that the patients can be referred to the other hospitals or vice versa.

3.3 Planning and promoting a new hospital

The planning and promoting is done from research and analysis and calculation of demand and supply for a given population catchment. And then gap is identified and a service plan is prepared accordingly.

3.3.1 Demand

A healthcare planner uses various tools and localised information to determine the demand of an area. This may be represented by Occasions of Service (OOS), Average Length of Stay (ALS), and Presentations Per Annum (PPA) etc. (IPHS, 2012). This is done by calculating the number of patient coming in from in and around the catchment area, the speciality they are looking forward to, and what is not being catered. The second calculation is done for incoming patients from one area to another. These calculations also include level of self-sufficiency desired as per the basic requirements mentioned in each type of hospitals. After all the three calculations, a basic formwork of the hospital need is created to cater the patients in such a way that it benefits the patients in and around the catchment area.

The demand is calculated for 10 -20 years in future. The year for which it is been built for is known as base point or base year. (IPHS, 2012) . The characteristics of the population plays the major role in determining the demand of the area.

3.3.2 Supply

This means the facilities being provided to the patients who are coming to the existing hospitals in the present.

3.3.3 Gap

The difference between the demand and supply is the gap for that catchment area (IPHS, 2012).

This gap has to be fulfilled by providing the needful facilities in the hospitals. Determining the gap helps in **need analysis, feasibility analysis and cost analysis.**

3.4 Assessment of need

There are several aspects that needs to be looked at and various questions that should be answered while designing a hospital (Burton R. Klien, 1989) .After having all these questions answered, the final assessment of need is finalized. It should be noted that final outcome for assessment of need should include,

- Frequency with which the population visit health facilities the services
- The services they require when they arrive there
- The capacity of individual staff members or items of equipment to satisfy their requirements that should

influence the size and distribution of services at various facilities.

- Any discrepancy between the services which are available and those which should be available should be established.

This is achieved by various statistical analyses for the population in the catchment area.

3.4.1 Situational Analysis

Situational Analysis helps to define what is the current stage of the problem to be addressed and what should be the actions to progress further, it helps in forecasting the results if the decision is to be taken in a particular direction. It helps us to identify the need of the region.

State wise Health profile is studied and presented by Central Bureau of Health Intelligence (CBHI, 2019) the situational analysis of the catchment area comprises of

- Geographical data
- Population Data
- Vital Statistical Data
- Socio economic profile of a region

3.4.2 Health profile of the region

Health profile of a region provides an overview of communicable and non-communicable disease prevalence over the region. The study helps to set priorities of the amenities to be provided for the catchment area. National Crime Record Bureau (NCRB), Ministry of Home affairs and CBHI provides data for health profile of the region.

3.5 Feasibility Analysis

Feasibility Analysis is a process for the evaluation, documentation and approval of project to assist with the development and procurement of sustainable healthcare infrastructure (IHFG, 2015)

In the case of private facilities, they must be based on sound business principles, be capable of capital and recurrent funding and long term operations. Public facilities must demonstrate value for funds received by the government and clear and holistic benefit to the community. Feasibility report help us to boost knowledge about the options available, Property Assessment, project confidence, Funding and capital Raising. It is very important part of a project report as it tells about how the infrastructure is going to perform in the future.

In Public or government sector a feasibility report would broaden the scope in order to identify the new opportunities and solutions to it. In India NHP looks closely at the public demand and supply and takes necessary actions in improving the current government schemes or propose new schemes.

A feasibility report comprises of various feasibility studies such as:

3.5.1 Health need and supply assessment

Health need assessment comprises of the overall quality inspection report by the facilities provided by the existing infrastructure in and around the city. It gives us an understanding about the present situation of the health care provided in the region. There are 3 methods according to IHFG (IHFG, 2015) the assessment can be performed

3.5.1.1 Projection from the past trends

In this method historic data of few past year (not older than 5 years) is used to examine the future trend of the demand. This can

speed up the process of the assessment but the validity of the data will be questionable and can thus be misleading. Also, the problem arises when the sample size available is too small or the data available is too old.

3.5.1.2 Benchmarks

In this method, a simple benchmarking process is used to apply the experience in one location to another, similar location. For example, a new population center may not currently be served by healthcare facilities, requiring the patients to travel long distances. This may be compared with similar population centers which are served by a few, busy and profitable healthcare facilities. Therefore it can be concluded that there is a need for at least one new healthcare service at the population center.

3.5.1.3 Pure population based assessment

The assessment is done usually by a survey of the patients and locals being catered by the existing facilities. The methods can be different according to the situation but the output should include the following information very clearly

1. Key Planning Units or KPU's (Default in these Guidelines) including:
 - Number of beds
 - Operating Theatres
 - Emergency Department Cubicles
 - LDR Birthing Rooms
 - Diagnostics facilities
 - Consulting Rooms (OPD and IPD)

Some of the above KPU's such as Beds may be further broken down into Adult vs Pediatrics', Medical vs. Surgical or classified by Service Lines.

2. Alternatively, the following activity-based supply measures may be used:
 - Bed days
 - Admissions
 - Discharges
 - Separations
 - Episodes of Care
 - Occasions of Service
 - Operations P/A

In practice, most Private healthcare facilities keep their activity confidential. This makes the Supply Analysis of the catchment area difficult or unreliable. It is often easier to obtain the KPU information from the facilities as they are advertised on their website or the hospital itself. However, local health authorities also provides such information for the purpose of supply analysis. But these data holds the probability of inaccuracy.

This assessment also gives a keen knowledge about the competitors in our business model. New business strategies will be formed if needed as all other medical facilities also follows the same method for identification of service gap. Private facilities can approach for a solution that is more profit driven and Government facilities can focus providing the maximum benefits to the population in the catchment area.

3. Restricted services

It is important that both Public and private facilities be in contact with the restricted services providing facilities (Super specialties). Such services are typically those which require extensive resources and skills but involve relatively small number of patients. These will be the first referral units for the patient in need, therefore to insure patient safety it is important

to collect data for these services as well. By these data one will be able to choose the best facility provider and refer the patients accordingly. These Super specialties services have a lot bigger catchment areas as it gets patients from all over the country.

3.5.2 Financial assessment

Financial assessment is the biggest difference in Public and Private Projects, as public projects works for the welfare of the citizens whereas private facilities works on a business model.

3.5.2.1 Calculating the costing

While working on the financial assessment various costing needs to be done, this includes (IHFG, 2015)

- **Capital cost:** Capital Cost represents the total cost of construction including all necessary fees and charges to completion, but not the cost of borrowing, leasing or land (IHFG, 2015). This includes,
 - NCC (Net construction cost)
 - GCC (Gross construction cost)
 - TPC (Total project cost)
 - TEC (Total End Cost)
 - TPC + escalations %
- **Transition costs** Transitional costs are neither part of the Capital costs (as typically quoted by builders) nor a Recurrent Cost. However they are necessary in order to realize the proposed project. Therefore they should be part of the budget. Transitional costs include:
 - Decanting costs (relocation cost)
 - Temporary Facilities
 - Recruitment costs
 - Change management cost
- **Opportunity costs:** refers to the loss of potential benefits from other options when one option is chosen (Handley, 2019). In government health care it's more of cost-effectiveness studies. That means what is the highest value manner in which to allocate resources to produce health benefits. For private project, like any other project the opportunity cost can be positive (income gain) or negative (income loss). **For a project to be feasible the opportunity cost should be positive.**
- **Recurrent costs:** it refers to as running cost or operational cost. As discussed earlier , it is usually divided in two major categories,

HR costs: includes the salary of the staffs, medical supports, site services, administration and clerical.

G&S costs: Administration, Domestic Supplies and Services, Drugs, Equipment Leasing, Food Supplies, Medical & Surgical Supplies, Motor Vehicle Expenses / Travel, Other Goods and Services, Patient Transport (including ambulance), Rental Accommodation, Repairs Maintenance and Renewals, Support & Special Services, Utilities, Insurance and Legal Costs and Others.

- **Life cycle costs:** the analysis of the recurrent cost for at least 10 years into future from the date of completion of the project. In this process, the total costs are analyzed with the benefits that may accrue in the future. Since starting capital costs may not be an accurate representation of how much a project will eventually cost, life-cycle costing includes all costs associated with ownership, including maintenance and disposal costs, to enable better decision making (Slowiak, 2010).

The Net present value (NPV) for each year should also be calculated to get the overall picture of the investment.

3.5.2.2 Revenue and profitability

The whole purpose of the financial assessment is to calculate the expected revenue from the project. The source of the income in private hospitals will be either from patients through insurance payment, direct payments and in government hospitals will be funding from government. (IHFG, 2015) The revenue to be earned in future can be calculated by

- Direct calculations based on expected throughput and rates of payments
- Benchmark against other existing operations
- Project the past revenue into the future and update for any increased volume

In case of private facilities, it is important to showcase the degree of profitability beyond the break –even point (year when the total cost and total revenue are equal) because it is a matter for the investors to determine, approve and require. The investors will only invest when they see profit in the project. Similarly, in case of Taking a loan from the bank for the construction of the health facility, it becomes important for the owner to foresee the profitability of the project as he has to pay the loan instalments and make profit as well after certain years. After achieving the break-even point, it is ascertain that after this the owner starts generating profit.

3.5.3 Risk assessment

Currently, in most countries, the major challenge within the health sector is to achieve a high quality healthcare service with limited available capacities. (HIROC, 2014) This often imposes enormous risk impact on performance of the healthcare institute. Therefore there is a need of identification and analysis of risk that can affect their performance and put patient safety at high level of concern. To cater this, efforts have been made by various researches to measure the patient experience with quality of the care given by the hospital (Zuheri, 2019).

Zuheri in his research (Zuheri, 2019), has presented a tool for assessment and analysis of the risk related to quality of the services, with the complaints by the patients being the main input. He proposes **probability impact matrix** as the tool to prioritise and develop an effective strategy to cater to the effect of the risk.

3.5.4 Findings and recommendations

After going through all the above assessment (health need assessment, financial assessment and risk assessment) the major findings and recommendations on marketing, financial, technological and organisational sectors are presented before the owner or client so that he can take clear decision.

3.6 Facility Management

Facility management is important for a hospital because it is an efficient tool to ensure functionality, comfort, safety and efficiency of the built environment by integrating people, place, process and technology. For example, management maintains facilities by preventing power or equipment failures so that there will be no interruption during surgical operation. Facility management also takes care of the staff and the amenities they need like the availability of nurse station near to the wards, the locker rooms, and other necessary amenities needed by the healthcare services. Another important scope for facility management is provide an efficient services system to the building such as HVAC, Electrical, MGPS, fire protection, etc. cost saving and cost effectiveness in the planning should also be kept in mind while planning for the facilities.

To understand the content of facility management a report by Stat Consultancy, Kerela is taken for example (consultancy, 2019). Their approach to facility management is

1. Need analysis for the facility management in the infrastructure

2. Conduct energy audit for the facility
3. System analysis for value measurement and their interpretations
4. Development of infrastructure up gradation plan
5. Development of SOP for facility management
6. Training staff and personnel based on the plans developed

3.6.1 Utility Management

Utility systems in a hospital include all the system prevailing in the hospital which is being used by the patients, staffs and visitors. The objectives of a successful utility system management plan are:

1. The system should comply with all safety regulation and standards which are relevant to that area.
2. Providing a controlled, safe and comfortable environment for staff, patients and visitors
3. Ensuring the operation reliability of the systems as
 - Infection control system (transmission of infection from one person to other by any possible means)
 - Direct life control system (ICU, CCU, NICU, OTs, etc.)
 - Non- life support utility system. (general ward, special ward)
4. Reducing the potential for hospital acquired illness (using the common amenities and not being in sanitized environment)
5. Assessing risk associated with the utility system failures and providing an alternative plan for the same.
6. Establishing coordination between the different utility systems for no interruptions
7. The program and policy of the organisation should be maintained in the systems.
8. Timely maintenance program should be made according to the systems involved.
9. Provide **plan of response** to the utility system failures.

3.6.2 Key Performance Indicator (KPI)

Key performance indicator is a quantifiable measure used to evaluate the success of an organization in meeting the objective of the performance. KPI is used by a facility manager to ensure the annual performance related to the utilities and the equipment's and is expected to work out the following:

Age coefficient (ACy): a coefficient for the adjustment of maintenance needs for each particular year with respect to the mean annual expenditure along the designed life cycle (DLC) of the facility.

Annual Maintenance expenditure (AME): the expenditure on maintenance per sqm to be built (excluding cleaning, energy and security expenses). This helps the owner to assess the overall expenditure with reference to the turnover (from financial assessment)

Building performance indicator (BPI): the evaluation of overall state of a hospital building with respect to its performance of components as well as whole system. This enables the owner to evaluate the overall state of facility, to inter- organizational benchmarking and intra organizational benchmarking

Maintenance efficiency indicator (MEI): examines allocation of resources for maintenance in relation to facility's performance. The coefficient enables the delineation of the source required for replacement and maintenance activity If

- $MEI < 0.37$ – high maintenance resource utilization efficiency, and/or lack of resources

- $0.52 \leq \text{MEI} \leq 0.37$ - normal use of maintenance resources
- $\text{MEI} > 0.52$ - high input in comparison with the actual performance, and/or surplus of resources.

The most crucial part of designing a hospital is designing its services. If the services of the hospitals are well worked upon and does not interfere in performance of one another, then the hospital is said to be an effectively designed. Since hospital caters the most vulnerable occupants who are dependent on others for their survival therefore it is important that the design of a hospital should revolve around all its services such as HVAC systems, Electrical systems, MGPS systems as well as Fire protection system.

3.6.3 HVAC systems

The HVAC system proposed should follow all the necessary codes and standards also special consideration should be taken for infection control in case of healthcare buildings. **NBC 2016 PART 8 Section 3, Table 6 deals with the guidelines for parameters to be considered for HVAC system design for Health Care Facilities and table 7 is for the guidelines for filter efficiency requirement in health care facilities.**

(NBC, 2016) **8.1.1 Say that following parameters which should be taken into consideration while designing HVAC systems for healthcare facilities:**

1. Temperature and humidity requirements of various spaces;
2. Ventilation and filtration requirements for contamination control;
3. Restriction on air movement between adjoining spaces;
4. Permitted tolerance on environmental conditions;
5. System reliability and maintainability; and
6. Adaptability of the system for fire emergency and for smoke management.

Provision for the schedule of regular inspection of filter performance monitoring equipment, air pressure sensing equipment, and airflow rate sensors is to be managed by the facility manger.

3.6.4 Electrical systems

The electrical and allied systems shall comply with NBC part 8 section 2. Attention should be given to

(consultancy, 2019) A risk management scope is advised to enhance the safety of electrical installation. In this the clinical locations are classified under 3 groups based on the **level of criticality** of the treatment and whether any loss of power will compromise patient safety. For instance group 0 and 1 can tolerate 10 seconds of power loss (in emergency) as the equipment used are in contact with only the external part of the patient's body. Group 2 are high risk locations and can only tolerate the power loss for 0.5 seconds as the equipment are in contact with patient's internal body parts.

3.6.5 MGPS systems

The designing, installation, functioning ,performance, documentation ,testing and commissioning of Medical Gas pipelines system should comply to Indian standards (IS7396, 2013)

The safe operation of medical gas pipeline system relies on **skilled staff** that understands the system and can be relied upon for the patient safety in case of emergency. The priority level is decided by the level of criticality again. The need of the staff managing and using the MGPS will be considered to be the final risks. Each risk is then attributed a priority level and high priority risk are used to develop a remedial action plan.

3.6.6 Fire protection Systems

A building should comply with (NBC, 2016) part 4 for its fire protection requirements and installation for institutional buildings.

The first step towards the planning for a fire protection system is that, the **fire must be prevented; Fire safety through systems can be achieved by**

1. Fire protection plan
2. Safety precautions
3. Smoke extractors
4. Compartmentalization.
5. Egress
6. Evacuation
7. Staff responsibilities:
 - At least 40% of the staffs should be trained in fire safety
 - Evacuation as well as fire safety plan to relocate patients to care areas
 - Transmission of alarm to the concerned

3.7 Architect's Brief

Once the facility manager has decided upon the amenities at services at different locations and floors of the infrastructure, a clear floor wise brief is given to the architect for designing according to the need of the project. This includes

1. The different standards to follow from different consultants. A different report is prepared for the set of standards to be followed by an architect is Design Basis Report (DBR).
2. The Architect is to be provided with space program of the facility. Space program include (Matani, 2013)
 - Department wise area allocation
 - Breakdown of space requirement of key department
 - Distribution of beds
 - Department wise space plan
 - Ward wise space plan
 - Laboratory plan
 - CSSD, administration and other amenities plan
3. (Matani, 2013) For each department such as OTs, ICU, NICU, CCU, radiology department, CSSD/CSPD department, a clear description of its
 - Function
 - location
 - key factors influencing complex planning,
 - basic functioning and special need ,
 - circulation plan of patients equipment and supplies,
 - relationship with other department,
 - Equipment description (company and its size)- IMPORTANT because the rooms carrying the equipment are built differently, the last wall is always constructed after placing the equipment in the room.
 - other area before entering and after leaving the department,
 - dirty utility,
 - other amenities for staff and patients,
 - water supply,
 - other essential amenities needed,

- lighting requirements(intensity, and priority positions) humidity,

Final detailed Design: when the drawings are completed in full included the services drawings, structural drawings, working

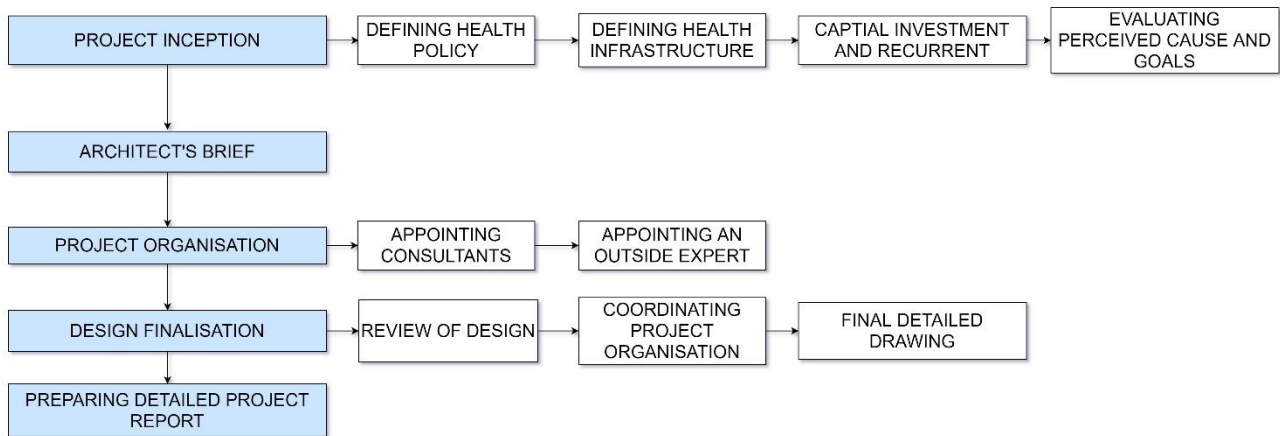


Figure 2: Flowchart showing planning process of government hospital in India

- temperature and humidity
- openings should be provided

4. If the owner is looking forward for accreditation to green building or any other authority, the guidelines for designing should be mentioned in the brief.

3.8 Project organization

Project organisation is the team of the stakeholders working together on the planning and execution of the project. There are two ways of forming a project organisation

1. By inviting tenders from different consultants for their respective part of work.
2. By hiring the consultants directly based on the past experience.

3.9 Appointing an outside expert/ CONSULTANT

Experts can be appointed at any phase of the project. Outside experts is appointed in case

1. there is a need of an expert with the client requirement of new technology, innovation or equipment,
2. If there is a need of second opinion on any problem encountered
3. There is lack of experience in the team,
4. An unforeseen situation is encountered

Outside experts may include

- Specialist (Doctor)
- Equipment vendor
- Disaster management specialist
- Green building specialist

3.10 Design finalization

Design finalisation usually takes 3 major steps

Review of design: From concept, site planning and design, everything has to be reviewed in order to assure the quality or the project to be built.

Coordinating project organisation: various changes happen while designing a building, each of the consultants contributes in successful functioning of the building so it is necessary for whole project organisation to be updated about the changes made in design so that they can have alternate solution of the problem.

drawing, site layout etc. and the client is satisfied following which, the next step will be proceeding towards approval and construction. The design is finalised.

3.11 Detailed project report

Detailed project report is the compilation of all the above discussed points. A detailed project report should showcase all the points mentioned above.

Figure 2 is a flowchart showcasing process of planning a government hospital. As discussed earlier government hospitals falls under one scheme or the other which is proposed by the state or the central government. Under the first step i.e. Project Inception. Government collects all the necessary data, undergoes several feasibility studies, defines the infrastructure to be made and prepared the project brief or the architect's brief which is handed over to the concerned Architect or the department who is in charge of construction of the project. Now these department and architect are sometimes hired directly based on past record or a competition or a RFP is floated by the government and chosen accordingly. Once the organization is finalized, design is worked upon and detailed project report is prepared which includes detailed estimate of the project. When any department is hired directly from the government directly for the execution of work, the department can ask for the sanction of difference in amount of preliminary and detailed estimate.

Figure 3 is a flowchart showcasing the process of planning a private hospital. Each of the steps are discussed above.

As we can see that there is a difference in the process in government and private hospitals. It is **not** representing that the government hospitals lacks these steps. It is because

- Most of the steps are covered in the project inception stage in case of government hospitals.
- Government hospital charges are negligible so that everyone can afford the facilities, Therefore the risk of failure of a project is next to zero in government hospitals thus it does not need to give so much thoughts upon the revenue generation and profitability.
- On the other hand private hospitals as based on business model and charge a considerable amount of money which everyone can't afford. The investment in building a hospital is huge amount of money therefore they have to be considerable for the revenue generation and profitability.

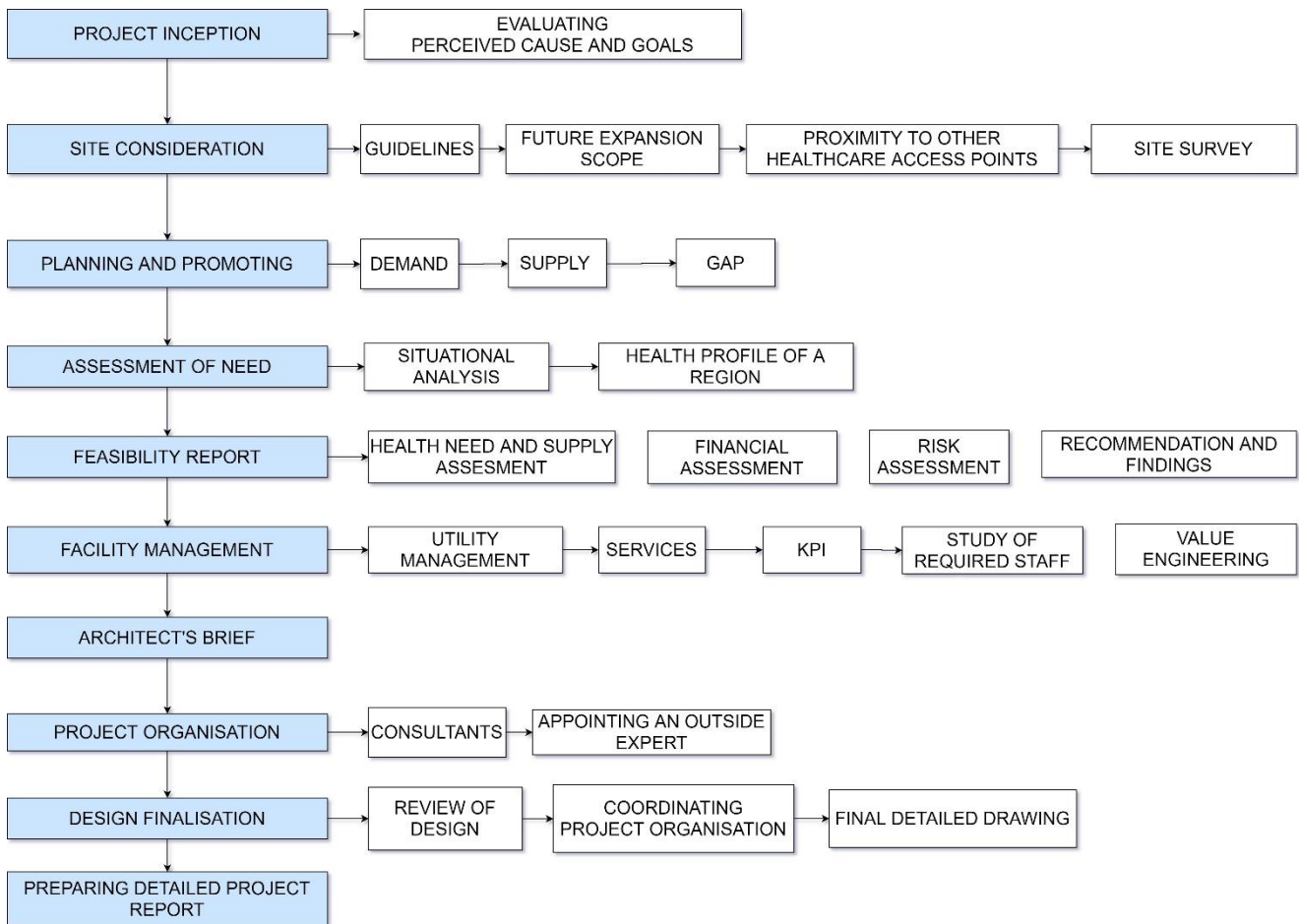


Figure 3: Flowchart showing process of planning a private hospital

- Government hospitals, does not need any sort of approvals as the scheme proposed and DBR issued for designing includes the standard to follow. Whereas the private hospitals need approvals for the land use, water supply, fire department and local authorities, therefore it becomes an intense procedure and everything has to be done according to the guidelines available.
- Government hospitals are built or elevated under government schemes. These schemes works on a bigger picture for improving Healthcare industry in India and focused on a particular area whether a disease, an awareness programme, provision of AIIMS etc., all these schemes comes with their won study of demand , supply and gap. Therefore the

requirements are pre-defined by the government, only a little moderations are made from site to site. So for every hospitals they need not to work upon framing the requirements altogether, looking at the profile of the state, little modifications are made.

4 ROLES AND RESPONSIBILITIES OF STAKEHOLDERS.

As it is knows to all of us that stakeholders are anyone who is associates with the project be it government, investor, client, facility manager, patient, architect, etc. Figure 4 shows basic hierarchy of stakeholders through a network diagram, however, the stakeholders highlighted in red box can be interchanged with one another as the hierarchy totally depends on who is appointed first by the client and then the other two depends on who appoints

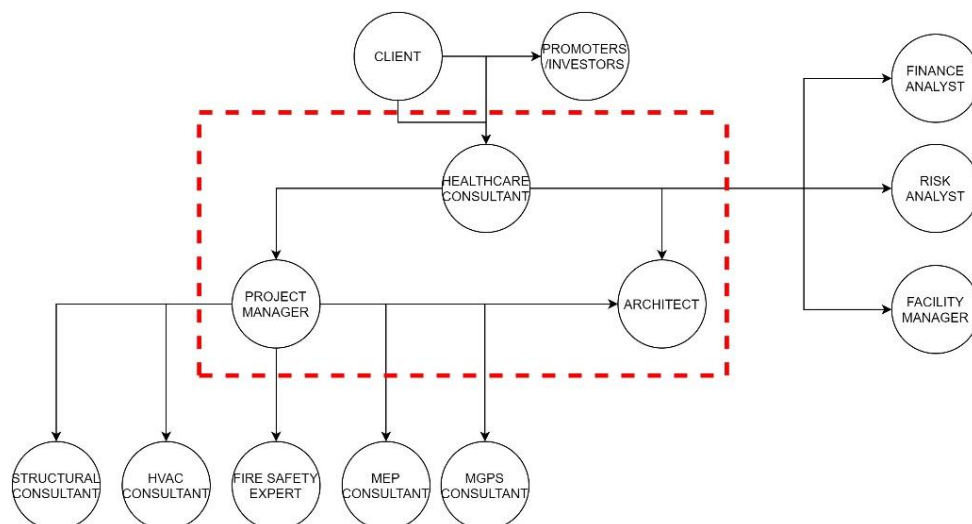


Figure 4: Network diagram showing hierarchy of stakeholders

whom. For a deeper understanding of their individual contribution in whole process and to find out who are the people which are responsible, who should be consulted who should be informed and who should be accountable at step, each step and stakeholder deliverable is studied in detail and is represented in table 1.

The Stakeholders are analyzed as per the WHO guidelines (Schmeer, n.d.) . And then RACI analysis is done by making an assignment matrix (table 1)

Table 1: assignment matrix using RACI analysis of Stakeholders and their deliverables

S.NO	PROCESS	DELIVERABLES	STAKEHOLDERS								STANDARDS/GUIDELINES TO REFER	
			Responsible		Accountable		Consulted		informed			
			Govt.	Private	Govt.	Private	Govt.	Private	Govt.	Private		
1 Project inception												
1.1	Defining health policies	Defining goals and objective of the policies.		government authority or promoter/investor					Health care consultant		THE SCHEME guideline (govt.)	
1.2	Defining health infrastructure	Defining the expected infrastructure for fulfilling the need of the health policy.	Ministry of health / state government programs	government authority or promoter/investor	government authority or promoter/investor	ministry of health / state government programs		N/A	Health care consultant/project managers	N/A		client/owner
1.3	Overview of what is available	Provide a clear report of which health care services are available in macro as well as micro level.							Health care consultant			
1.4	Capital investment and recurrent cost	A detailed account of the capital cost investment and the recurrent cost implication		financial analyst			healthcare consultant		healthcare consultant			promoter/investor
1.5	Perceived cause and goals	To have a check on the perceived goal in already existing facility	consultant committee	healthcare consultant			hospital administration	facility manager		execution committee		client/investors
2 Site considerations												
2.1	Area and space norms for the hospitals	Clearly mention of the minimum requirement of site area according to standards.	government authority			healthcare consultant		project manager		chief executing committee	hospital administration on	CPWD
2.2	Site selection criteria	the physical description of the parameters to be considered while selecting a site										
2.3	Factors to consider	For a district/tertiary care hospital what should be the factors in locating a hospital should be specified.										

2.4	Site planning strategy(in already existing building)	What are the ideal conditions of a site to be fit for construction	government authority		healthcare consultant	project manager	chief executing committee	hospital administration on	CPWD		
2.5	Future expansion scope	Consideration for future expansion									
2.6	Considering patient friendly environment	The guideline to make a site a patient friendly									
2.7	Proximity to other healthcare access points	Study of other healthcare access point and services they provide	N/A	surveyor	N/A	healthcare consultant	N/A	surveyor	N/A	hospital administration	
2.8	Site survey	A detailed site report mentioning the geographical, topographical data as well as soil investigation report.	geotechnical expert		project manager	chief executing committee	healthcare consultant	ministry of health / state government programs	client/owner	IS 1888: 1982 IS 1892: 1979 IS 2131: 1981	
3	Planning and promoting a new hospital										
3.1	Identifying Demand, supply and gap	A brief study of demand , supply and gap identification for the catchment area	Ministry of health / state government programs	surveyor	ministry of health / state government programs	healthcare consultant	government statistics	N/A	hospital administration	IPHS	
4	Assessment of need										
4.1	Situational analysis	The report should include study of population, geographical, vital statistical and socio economic profile of the region	government statistics		Ministry of health / state government programs	healthcare consultant	N/A	surveyor	N/A	hospital administration	CBHI, NCHS
4.2	Health profile of region	The report should include the current health profile of the region. Including BOD, DALYs cause and cases.									NCRB, Ministry of home affairs, NCHS
5	Feasibility report										
5.1	Health need and supply	Position of already existing facilities		surveyor				patients		administration	IHFG

5.2	Financial assessment	Calculation of costing, revenue and profitability for the future.	Ministry of health / state government programs	finance analyst	ministry of health / state government programs	healthcare consultant	N/A	surveyor	N/A	promoter/investor	IHFG
5.3	Risk assessment	Identification of risk associated		risk analyst				project manager		hospital administration	
5.4	Recommendations and findings	Expert opinion on improving the program aiming to better performance of the Facility in future.		project manager				risk analyst		hospital administration	
6	Facility management										
6.1	Utility management	Key planning units, efficient utility Management plan, movement pattern flowchart, floor wise distribution	Ministry of health / state government programs FACILITY MANAGER IS HIRED IN CASE OF REDEVELOPMENT OF EXISTING HOSPITALS	facility manger	ministry of health / state government programs	hospital administration	facility manager	doctor	N/A	architect/client	IPHS
6.2	Key performance indicators	System for tracking performance and maintenance of whole building and integrated systems		vendor				architect /client			
6.3	Services	Standards and special recommendation for the services to be provided in healthcare		respective service consultants	ministry of health / state government programs	healthcare consultant	facility manager	project manager	N/A	architect	
6.4	Study of Required staff and amenities	A brief listing of required staff along with the qualification.		facility manger	hospital administration	healthcare consultant	hospital administration				
6.5	Value engineering (if requested)	Value engineering report (if requested)	N/A	N/A	project manager	healthcare consultant	promoter/investor				
7	Architect's brief	A clear architects brief for a successful evaluation of the idea	campus monitoring committee	facility manger	ministry of health / state government programs	healthcare consultant	project manager	hospital administration			
8	Project organization	Forming project organization by deserving and needful team	executing agency	project manager/healthcare consultant				owner/client	N/A	hospital administration	healthcare consultant

9	Appointing an outside expert	Appointing an expert to solve the problem faced at any stage of the project.	campus monitoring committee	healthcare consultant		owner/client		project manager	N/A	hospital administration	
10	Design finalization										
10.1	Review of designs	Based on standards and recommendation of project organization	campus monitoring committee	facility manger	ministry of health / state government programs	healthcare consultant	N/A	project manager	N/A	owner/client	
10.2	Coordinating project organization	Maintaining transparency between all stakeholder for successful design		healthcare consultant /project manager		project manger		respective services consultants		owner/client	
10.3	Final detailed design.	Producing drawings and other needful for the final design finalized	construction agency	architect	campus planning committee	project manger	N/A	healthcare consultant	N/A	hospital administration/ client/ owner/ investors/ promoters	NBC
11	Detailed project report	Preparing of DPR including all the above mentioned points that would give a clear idea of successful running of the project	master planning consultant	healthcare consultant /project manager		healthcare consultant		architect			

5 CHALLENGES PREVAILING IN HEALTHCARE INDUSTRY IN INDIA

As we saw the planning process as well as the stakeholders responsible behind the processes of a government hospital and a private hospital is quite similar but somehow both the hospital have their own strengths and weaknesses. The problem with government hospital is that it fails to accommodate the crowd gathering at the hospitals and private hospitals overestimates their business and increase the charge of their services so much that it becomes unaffordable to the common man.

Focusing on efficient process and involvement of stakeholders will increase the productivity at the pre planning stage of a design. But the healthcare systems in India are facing much more challenge. In a survey conducted by the author it was found that 72.8 % of 114 respondent preferred to visit a private hospital over a government one because it saves time and the quality of the service they provide is better than that of a government one. The remaining 27.2% chose government hospital just because it was affordable. Therefore there has to be a way that balances the two scenarios.

Through the Rural Health Statistics report 2018-19 (GOI, 2018-19) it is visible that India is facing significant shortfall of infrastructure, staff and amenities in the existing infrastructure in Primary community as well as districts care facilities in Rural, urban as well as tribal areas. Apart from this factors like neglecting modern technology, lack of medically insured citizens and lack of services in rural areas are most important issues at the present.

In the same survey conducted by the author, it was found that the people choosing private facilities were most unsatisfied with the location of the facility, whereas respondents who chose the government facility were most unsatisfied by the limited capacity of waiting area.

6 CONCLUSION

The process of planning a tertiary care government as well as a private hospital has been discussed in details along with the stakeholder involved. But looking at the above challenges it is ascertain that just following the process won't help to improve the current situation of the healthcare system. First of all it is very important that the institution should run on a PUBLIC-

PRIVATE- PARTNERSHIP model where the load of the patient be shared among both private and government hospitals. Some of the suggestion to improve the current state of healthcare industry are listed below.

Another important issue that was found is that the referral system in the Healthcare Industry is failing. The provision of a Primary Healthcare facility is as important as a community and a district healthcare facility. If we strengthen the PHCs, the crowd at the district hospital will be considerably less as more than 80% of the people rush to the nearest district hospital even for mild fever and cough. If they get a medical facility near to them, it would be helpful for the government as well as the people.

Having a clear understanding of the challenges is important so that the planning stage itself caters the major problem in one way or the other.

6.1 SUGGESTIONS TO OVERCOME CHALLENGES

6.1.1 LACK OF INFRASTRUCTURE:

The program should be expanded to absorb large number of patients and staffs.

- OPDs to be open 24*7 with shifts assigned.
- The referral system should be brought into effect. The emphasis to improve the PHCs should be laid first and then the CHCs. The peripheral services should be improved.
- Government should come up with new policies to strengthen the state hospitals as well.
- Emphasis should be given to a PPP model for construction of any new health infrastructure. For which in return of the govt. share, the privates should treat a fixed number of patients daily at similar rate as that of govt. hospital, provided that patient is medically insured by the govt. schemes.
- The facilities at the rural area should improve with housing facility to the staffs.
- Basic amenities such as toilet, kitchen, laundry, and housekeeping should be mandatory in every hospital buildings.
- Lack of staffs:
- New staffs should be admitted in the hospitals with a promise of a hygienic and safe environment.
- Amenities such as rooms should be provided appropriately in every healthcare.
- Training should be added as a part in their job where they would get growth and promotions time to time.
- Staffs for awareness programs should also be hired.
- More emphasis should be laid on opening new government institute of medical sciences and nursing

6.2 Interventions to bring in the planning processes itself.

As discussed earlier biggest challenge in private hospital is the location where it is built. And in case of government hospitals, the capacity of waiting area was found to be insufficient.

6.2.1 Challenge 1: Determining location of the site:

There are various norms set up by CPWD for selecting a potential site for a hospital which is explained in clause 3.2 of this report. Apart from that it is important to look at,

- Parking facilities available
- The site should have minimum exposure to traffic
- The site should be barrier free

- The site should be approachable by the locals as to the nearest referral services.

6.2.2 Challenge 2: Determining size of waiting area:

As we discussed earlier that there is a huge gathering of rural population at government hospitals. Therefore the waiting area should cater to the rising population as well as should comply the norms. The NBC norms defines the minimum space requirement not maximum so efforts should be taken while defining the space requirements should be

- Always be on plus size while designing the waiting area.
- The campus of the hospital should be so planned so that it can cater the population outside its waiting area as well. For example, the open areas can have solar panelled canopies with seats below it for the relatives of the patients to wait.
- Amenities for the relatives and patients should be improved such as appointment system can be done through smart devices, availability of drinking water, snacks and toilets should be considered while making a brief for the hospital.

7 REFERENCES

- [1] Apollo. (2018). *apollomunishinsurance*. Retrieved June 22, 2020, from <https://www.apollomunichinsurance.com/blog/health/the-major-healthcare-challenges-in-india.aspx>
- [2] Ashman, P. (2017). *Healthcare Challenges in India*. economic times.
- [3] Avneesh Kumar, S. G. (2012). *Health infrastructure in india: Critical Analysis of Policy Gaps in the Indian Healthcare Delivery*. Vivekanand International Foundation.
- [4] Bajpai, V. (2014). The challenges confronting Public Hospitals in India. *Advances in Public Health*, 2014, 27.
- [5] Burton R. Klien, A. J. (1989). *Health Care Facility Planning and Construction*. New York: van nostrand reinhold.
- [6] CBHI. (2019). *National Health profile*.
- [7] consultancy, S. (2019). *facility management in healthcare facility report content*.
- [8] CPWD. (2019). *Compendium of norms for designing og hospitals and medical institutions*. Central Public Works Department.
- [9] Dibyendu Ghosh, S. D. (2017). *Social Health and enviromental Infastructurs for Economic growth*.
- [10] GOI, M. (2018-19). *Rural Health Statistics*. New Delhi: MOHFW.
- [11] Handley, N. (2019). *Opportunity Cost: The hidden toll of seeking Health Care*.
- [12] HIROC, h. c. (2014). *integrated risk managemnt for healthcare organisation*. Toronto.
- [13] IHFG. (2015). *Part F- feasibility planning and costing guidelines*.
- [14] IPHS. (2012). A2. INDIAN PUBLIC HEALTH STANDARDS.
- [15] IS7396, I. S. (2013).

- [16] Kasthuri, A. (2018). Challenges to Healthcare in India. *Indian Journal of Coommunity Medicine*, 43(3), 141-143.
- [17] Matani, D. P. (2013). *an architectural brief for a proposed 100 bedded hospital*. issue.com.
- [18] Mehta, P. (2012). 7 major problems of health services in india. *economics discussions*.
- [19] Micheal Hopkinson, K. K. (1996). A GUIDE FOR PLANNERS AND ARCHITECTS OF FIRST AND SECOND LEVEL FACILITIES. In *Publication in relation to the Regional Workshop on Civil Works*.
- [20] NBC, N. B. (2016).
- [21] Per Kroll, P. K. (2003). *The Rational Unified Process Made Easy*. Addison Wesley object technology.
- [22] Schmeer, K. (n.d.). *Stakeholder Analysis Guidelines*. world health organisation.
- [23] Service, I.-A. N. (2019). *World Health Day 2019 :challenges ,opportunity in India's healthcare industry*. Retrieved June 25, 2020, from <https://www.firstpost.com/india/world-health-day-2019-challenges-opportunities-in-indias-81b-healthcare-industry-3544745.html>
- [24] Slowiak, P. F. (2010). *Life cycle costing in hospitals*.
- [25] UNITED, U. (2014). *St. Elizabeth East Campus Site feasibility STudy*.
- [26] Welfare, M. o. (2017). *National Health policy*.
- [27] Zuheri, A. A. (2019). *risk assessment and analysis of healthcare system -Impact matrix*. university of south Australia.

