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# PRACTICAL APPLICATIONS

## A management information system to plan and monitor the delivery of health-care services in government hospitals in India

Government hospitals  
in India

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**Keywords** *Management information systems, India, Health services, Hospital management, Information management, Performance criteria*

**Abstract** *Governments all over the world are getting increasingly concerned about their ability to meet their social obligations in the health sector. In this paper, we discuss the design and development of a management information system (MIS) to plan and monitor the delivery of healthcare services in government hospitals in India. Our MIS design is based on an understanding of the working of several municipal, district, and state government hospitals. In order to understand the magnitude and complexity of various issues faced by the government hospitals, we analyze the working of three large tertiary care hospitals administered by the Ahmedabad Municipal Corporation. The hospital managers are very concerned about the lack of hospital infrastructure and resources to provide a satisfactory level of service. Equally concerned are the government administrators who have limited financial resources to offer healthcare services at subsidized rates. A comprehensive hospital MIS is thus necessary to plan and monitor the delivery of hospital services efficiently and effectively.*

### Administration of government hospitals

In India, the Government at various levels such as municipality, district and state offers primary, secondary and tertiary healthcare to its citizens at highly subsidized rates. Primary healthcare services focus on problems related to childbirth, malnutrition, water borne and air borne diseases etc. Secondary healthcare services offered through municipal dispensaries and maternity homes offer basic outpatient services and limited inpatient services. Tertiary healthcare is offered through large general hospitals (hereafter referred to as government hospitals). These hospitals offer a wide range of outpatient and inpatient services, including a few super specialty services. Many government hospitals also serve as teaching hospitals for undergraduate and postgraduate studies in medicine and nursing.

Each government hospital is organized into several clinical, investigation, and administrative departments. Clinical departments such as medicine, surgery, pediatrics and so on deliver outpatient and inpatient healthcare services. Investigation departments such as laboratories and radiology departments assist the clinicians in the process of diagnosis. Medical store, finance and accounts, personnel,

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statistical departments and so on provide the necessary administrative support to the delivery of hospital services. Hospital services can be broadly classified into Outpatient services, Inpatient care, Surgical procedures, and Investigation services.

A hospital superintendent heads each government hospital. Hospital superintendents have the dual responsibility of managing their hospital resources in providing healthcare services to the patients, and extensively interacting with the bureaucrats in the municipality, district, or the state governments in the administration of their hospitals.

### **Working of government hospitals: a case study**

Ahmedabad Municipal Corporation (AMC) administers three large general hospitals, namely LG Hospital, SCL Hospital, and VS Hospital. Some important statistics of these hospitals are given in Table I. It can be seen from Table I that the combined load handled by these three hospitals for the year 1999-2000 is close to 1,200,000 outpatient cases, 110,000 indoor cases, 51,000 surgical operations, and 2,000,000 laboratory and radiology investigations.

An analysis of the data on patient load reveals the following trends. Over the years 1995-96 to 1999-2000, outpatient cases have gone up by 33 per cent, indoor cases up by 23 per cent, number of surgeries by 23 per cent, and the load on investigation services (laboratories and radiology services) by over 40 per cent. While the load on hospital services has increased rapidly during the above period, the financial health of AMC hospitals has deteriorated. Financial constraints faced by AMC have led to insufficient funds available with the hospitals for variable expenses towards patient care; as fixed expenses registered a growth from 77.5 per cent in 1995-1996 to 80.5 per cent in 1999-2000. Income from patient care as a percentage of the total expenditure on patient care has dropped from 16.3 per cent to 13.4 per cent during the above period. There is a need to revise the pricing of services, based on a clear understanding of the costs of providing hospital services.

Poor utilization of resources is another concern. Operating theatres and the investigation departments consume large amount of resources. However, these facilities are fully operational only during the morning shift from 8.00 a.m. to 2.00 p.m. Expensive resources in these facilities are therefore lying idle at other times of the day, to handle only emergency cases.

Administrative support from AMC to its hospitals is unsatisfactory because the municipal authorities do not differentiate healthcare services from other municipal services such as transportation, education and so on. Hospital superintendents have to obtain approvals from AMC authorities even for emergency purchases of drugs and medicines, and for recruitment of doctors on a temporary basis, arising from leave vacancies of permanent doctors. Frequent transfers of clerical staff between hospitals and other AMC establishments (transportation, education departments, etc.) also disrupt the normal working of the hospitals. The central medical store that manages the inventory of hospital supplies and maintenance spare parts to the AMC hospitals is not sensitive enough to meet the hospital needs in time. As a result, frequent stock-outs of materials are common in municipal hospitals. Lack of hospital supplies and spare parts directly affects the quality of patient care. Poor and irregular allocation of capital expenses by AMC to its hospitals and the procedural delays for investments in medical technology further add to the concerns of the hospital superintendents in delivering quality medical care.

Based on our analysis of the working of AMC hospitals, and an understanding of several other district and state government hospitals, we present in Table II, a

| Statistics                 | 1995-1996 | 1996-1997 | 1997-1998 | 1998-1999 | 1999-2000 |
|----------------------------|-----------|-----------|-----------|-----------|-----------|
| <i>VS Hospital</i>         |           |           |           |           |           |
| No. of beds                |           |           |           |           |           |
| General wards              | 877       | 877       | 877       | 877       | 1,017     |
| Special wards              | 68        | 68        | 68        | 68        | 68        |
| Total number of beds       | 945       | 945       | 945       | 945       | 1,085     |
| Patient load               |           |           |           |           |           |
| OPD cases: new             | 129,099   | 136,890   | 154,786   | 160,888   | 167,578   |
| Repeat                     | 289,125   | 325,469   | 363,216   | 327,118   | 402,394   |
| Indoor cases               | 45,997    | 49,264    | 53,571    | 54,904    | 54,938    |
| Surgical operations        | 21,567    | 22,005    | 23,673    | 23,794    | 24,683    |
| Radiology investigations   | 138,685   | 155,968   | 172,878   | 191,900   | 194,346   |
| Laboratory investigations  | 761,377   | 797,158   | 822,105   | 845,755   | 966,630   |
| Rev income                 |           |           |           |           |           |
| Income from patient care   | 28.13     | 31.94     | 38.02     | 30.93     | 37.04     |
| Rev expenses               |           |           |           |           |           |
| Salaries, wages, overheads | 124.32    | 159.11    | 172.60    | 174.09    | 199.90    |
| Consumables and disposable | 37.48     | 42.99     | 45.00     | 35.91     | 46.00     |
| Total (AMC funds)          | 161.80    | 202.10    | 217.60    | 210.00    | 245.90    |
| Cap expenses: AMC funds    | -         | 20.44     | 22.70     | -         | -         |
| <i>LG Hospital</i>         |           |           |           |           |           |
| No. of beds                |           |           |           |           |           |
| General wards              | 382       | 382       | 392       | 418       | 418       |
| Special wards              | 21        | 21        | 21        | 21        | 21        |
| Total number of beds       | 403       | 403       | 413       | 439       | 439       |
| Patient load               |           |           |           |           |           |
| OPD cases: new             | 81,317    | 90,760    | 96,883    | 106,596   | 114,271   |
| Repeat                     | 144,047   | 160,183   | 163,295   | 174,985   | 189,150   |
| Indoor cases               | 22,556    | 23,888    | 24,917    | 25,359    | 26,387    |
| Surgical operations        | 9,598     | 10,346    | 11,126    | 11,636    | 12,195    |
| Radiology investigations   | 62,415    | 73,273    | 82,514    | 86,321    | 97,454    |
| Laboratory investigations  | 383,418   | 416,399   | 444,332   | 475,234   | 563,404   |
| Rev. income                |           |           |           |           |           |
| Income from patient care   | 7.04      | 8.03      | 9.23      | 9.90      | 9.93      |
| Rev expenses               |           |           |           |           |           |
| Salaries, wages, overheads | 37.50     | 45.19     | 46.85     | 56.55     | 68.98     |
| Consumables and disposable | 10.20     | 12.51     | 16.65     | 19.05     | 20.72     |
| Total (AMC funds)          | 47.70     | 57.70     | 63.50     | 75.60     | 89.70     |
| Cap expenses: AMC funds    | -         | -         | 1.92      | 5.47      | 2.63      |
| <i>SCL Hospital</i>        |           |           |           |           |           |
| No. of beds                |           |           |           |           |           |
| General wards              | 394       | 453       | 453       | 453       | 453       |
| Special wards              | 12        | 17        | 17        | 17        | 17        |
| Total number of beds       | 406       | 430       | 470       | 470       | 470       |
| Patient load               |           |           |           |           |           |
| OPD cases: new             | 92,477    | 99,132    | 101,363   | 108,965   | 112,704   |
| Repeat                     | 155,468   | 170,150   | 183,053   | 200,172   | 200,623   |
| Indoor cases               | 20,202    | 22,886    | 22,831    | 26,309    | 28,158    |
| Surgical operations        | 10,391    | 11,089    | 12,488    | 13,783    | 14,410    |

(continued)

**Table I.**  
AMC general hospitals:  
some important statistics  
(Rs millions)

Table I.

| Statistics                 | 1995-1996 | 1996-1997 | 1997-1998 | 1998-1999 | 1999-2000 |
|----------------------------|-----------|-----------|-----------|-----------|-----------|
| Radiology investigations   | 48,897    | 58,699    | 65,319    | 76,901    | 79,838    |
| Laboratory investigations  | 372,699   | 434,683   | 531,540   | 562,022   | 576,278   |
| Rev income:                |           |           |           |           |           |
| Income from patient care   | 6.37      | 7.21      | 9.05      | 10.09     | 10.14     |
| Rev expenses               |           |           |           |           |           |
| Salaries, wages, overheads | 36.05     | 42.12     | 46.73     | 59.46     | 74.16     |
| Consumables and disposable | 9.15      | 9.58      | 12.17     | 14.54     | 16.04     |
| Total (AMC funds)          | 45.20     | 51.70     | 58.90     | 74.00     | 90.20     |
| Cap expenses: AMC funds    | -         | -         | 4.00      | 4.77      | 4.00      |

Source: (Statistical Outline of Ahmedabad City, 1998-1999)(AMC, n.d.)

| Working of government hospitals   | Implications on costs, revenues, and quality  |
|---|---|
| Patient load increases, hospital infrastructure remains the same  | Hospital resources are stretched beyond limits to offer services  |
| Government funds are limited, allocation for healthcare sector insufficient   | Unable to offer quality healthcare services at subsidized rates   |
| Fixed expenses account for almost 75 percent of the total revenue expenses, leaving very little money for variable expenses for purchase of hospital supplies (medicines and drugs, surgical items, lab items) and spare parts for the maintenance of medical instruments and equipment | Insufficient funds for variable expenses adversely affects the quality of patient care. Patients rely on private chemists for purchase of medicines and drugs, and on private labs for investigation services, and thereby end up paying higher rates to the private healthcare providers |
| Revenue income from patient care has increased only marginally. Input costs for healthcare services have gone up substantially  | Where is the government subsidy?<br>Pricing of hospital services is not in line with the input cost of providing services and the extent of subsidy the government wishes to offer  |
| No regular allocations for capital expenses   | Lack of resources leads to unsatisfactory level of services   |
| Operating theatres and investigation departments have expensive resources, used mostly during the morning shift 8 a.m-2 p.m., and lying idle at other times, except for handling emergency cases  | Under-utilization of the resources in these departments leads to real and opportunity losses of revenue from patient care   |
| The current organizational structure is not sufficiently sensitive and responsive to meet the needs of the hospitals  | Sanctioned posts remain unfilled for months<br>Temporary staff not committed to service quality   |
| The central medical stores follows old processes and procedures, and consequently its inventory management is highly unsatisfactory   | Inventory management of hospital supplies is critical when sufficient funds are not available for variable expenses   |
| The central purchase committee still follows outdated and antiquated processes and procedures for capital purchases   | Procedural delays add to the concerns on the quality of healthcare services   |
| Very poor interaction with public   | Unreal expectations from the public   |

Table II.  
Issues facing government hospitals

summary of the issues facing the government hospitals in India. The hospital superintendents are concerned about the shortage of hospital beds, high fixed costs, insufficient stock of consumables and disposable items, lack of proper infrastructure, and the insensitivity of municipal authorities to the problems faced by their hospital

staff. The hospital superintendents are stretching their resources beyond limits to offer services. Equally concerned are the government administrators who do not have sufficient financial resources to meet the healthcare needs of the citizens satisfactorily. Planning and monitoring the performance of municipal hospitals have thus become critical in order to offer efficient and effective healthcare services.

Traditionally, analysis of hospital systems have focussed on the working of various departments offering particular services, such as scheduling of appointments for outpatients (Brahmi and Worthington, 1991), planning of emergency departments (Gabaeff and Lennan, 1991), shift-scheduling of nurses (Siferd and Benton 1994), etc. Some of the recent developments in management research advocate activity based costing (ABC) methodology and business process re-engineering (BPR) approach to offer cost-effective value added hospital services. ABC methodology was adopted for estimating the costs of surgical procedures (Baker and Boyd, 1997; Lakhia and Ramani, 2001). Leicester Royal Infirmary NHS Trust, UK re-engineered its procedures in coordinating the patient-visits to various clinics in order to offer good services at low cost (Newman, 1994). St James Hospital, UK, re-engineered its purchase and supplies departments by adopting a BPR approach (Bence, 1995). MP Trust Hospital, India replaced its legacy inventory systems for hospital supplies with a DSS Enabled Materials Management Process (Ramani, 2001).

Our paper discussed below, takes an integrated view of a hospital as a single entity, focuses on the information needs of hospitals offering a variety of services, and develops a management information systems (MIS) framework for effective and efficient management of general hospitals.

### **An MIS framework**

The role of MIS in any organization is to provide information support to plan and monitor the performance of the organization. Planning decisions to support the delivery of hospital services require a clear understanding of the hospital logistics to coordinate the activities of various units, such as clinical wards, operating theatres, investigation departments, hospital stores etc. Monitoring and control decisions include patient flow management, inventory management, billing for hospital services, and so on. In this paper we discuss an MIS to support the planning and monitoring of healthcare services in government hospitals.

Our first task in the design of MIS is to define performance indicators, and establish appropriate methodologies to estimate these indicators. Each clinical department provides a specialized service different from other clinical departments. Hence, it is necessary to monitor the hospital performance at the level of each individual clinical department. Similarly, it is necessary to monitor independently the performance of each laboratory department (pathology, biochemistry, microbiology, etc.) and each radiology department (x-ray, sonography, etc.) due to the basic differences in the nature and type of investigations carried out by the investigation departments. It is also necessary to estimate the performance of the administrative units, which support the clinical and investigation departments in the delivery of healthcare services.

### *Outpatient services*

All patients visiting any hospital for the first time in a year register themselves as outpatients by paying a registration fee, and collect an outpatient registration booklet. Based on the descriptions of the illness, the outpatient department (OPD) clerk at the registration desk recommends an appropriate clinic. Following the clinical examination by a senior doctor (called consultants), each OPD patient is advised a

certain line of treatment that consists of investigations to aid diagnosis, medication, OPD procedures, or admitted for treatment as inpatient. OPD patients (except those requiring inpatient care) make the necessary payment for all the hospital services required, and proceed to the respective service centers. After completing all the activities, such as giving samples to the laboratories for investigation, they take appointments for their repeat visits. There is no registration fee for repeat visits within a certain period of time. The cycle of OPD visits continues until the treatment is completed (in 2-3 visits) or the patient is admitted into the hospital as an inpatient.

Outpatient departments in many government hospitals follow a weekly schedule, since not all clinical departments offer outpatient services every day of the week. For example, the medicine department at an AMC hospital offers outpatient services six days a week, while its orthopedics department offers outpatient services only three days a week. The weekly load on OPD is therefore different for different clinical departments. The load on OPD is also different for new and repeat patients. New cases consume more resources (more time for consultation, more lab and radiology tests, and so on) than repeat cases.

Accordingly, some of the performance indicators for outpatient services are:

- average number of new vs repeat cases seen/consultant/hour for each OPD;
- average number of outpatients (new + repeat) seen/consultant/hour for each OPD;
- average waiting time for consultation for new vs repeat cases for each OPD;
- average number of visits to complete outpatient treatment for each OPD; and
- average cost (per patient) of treatment for each OPD.

In order to estimate these indicators, let us define the following variables:

$O_{ij}(\text{New})$  = number of new outpatients seen by consultant  $i$  in dept.  $j$  per week.

$O_{ij}(\text{Repeat})$  = number of repeat outpatients seen by consultant  $i$  in dept  $j$  per week.

$H_{ij}$  = number of hours spent by consultant  $i$ , dept  $j$  for OPD services/week.

Then for OPD <sub>$j$</sub> ,

Average number of new cases seen/consultant/hour =  $\frac{\sum_i O_{ij}(\text{New})}{\sum_i H_{ij}}$

Similarly, we can estimate the average number of repeat cases as well as the average number of patients (new + repeat cases) seen/consultant/hour. Average number of visits to complete OPD treatment can be estimated from the records maintained by the OPD registration desk when patients register as new/repeat cases. The average cost per OPD treatment can be estimated easily from the OPD bills generated for each outpatient (see Figure 1), as outpatients are required to pay for all the services before availing any service. Average waiting time for consultation and other services can be estimated by carrying out a sample survey on patient flow through the system for a few weeks.

#### *Inpatient care*

Patients are admitted into appropriate clinical wards as inpatients based on the recommendations of their OPD consultants or as emergency cases. Each inpatient registers on payment of an indoor registration fee, collects an indoor registration booklet, and is led to his/her ward by a ward attendant or a staff nurse. The sister-in-charge (senior nurse) receives the inpatient, allots a bed, and the treatment

OPD. No. 1457476  
Name of the patient: xxxxx  
Status (staff/individual): Individual  
New/Repeat 1,2,3

OPD Name  
Date: 02-07-2001  
Time: 11:57:23

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| Sl.No. | ServicesMaterials             | Amount/Rs. |
|--------|-------------------------------|------------|
| 1      | Registration                  | **         |
| 2      | E.C.G.                        | **         |
| 3      | Urine Routine Analysis        | **         |
| 4      | FBS/PPBS/RBS                  | **         |
| 5      | Disposable Needle and Syringe | **         |
| 6      | Urea and Creatinine           | **         |
|        | Gross                         | **         |
|        | Net                           | **         |
|        | (Rupees in words: **)         |            |

Figure 1.  
Outpatient bill

begins. Inpatient care consists of clinical examination, medication, investigations, and surgical and other procedures as required. When the consultant is satisfied that a patient does not need any more hospitalization for treatment, he/she initiates the patient's discharge procedures. An indoor clerk prepares the bill for all the services during the length of the patient's stay. The length of hospital stay of an inpatient depends on the nature and seriousness of the illness. For example, the length of stay of an inpatient in a medicine ward may be a few days while an orthopedic patient could stay for a few weeks.

The two commonly used indicators to report the performance of inpatient services are:

- (1) average bed occupancy; and
- (2) average length of stay.

An equally important indicator which reflects the efficiency of service delivery is: the average cost of treating an inpatient.

It is important to realize that the three indicators mentioned above have to be independently estimated for each clinical department as each clinical department offers a specialized healthcare service. Many hospitals report these figures for the hospital as a whole as part of their statutory reports, which are not very useful for management decision making.

Average bed occupancy for each clinical department can be easily computed as the ratio of the number of beds occupied in a month to the total number of hospital beds in that department.

Average length of stay of an inpatient can be estimated as follows. Define:

- $n_j$  = number of inpatients discharged by the clinical department  $j$  in a month; and  
 $d_{ij}$  = length of stay (in days) of an inpatient  $i$ , discharged by department  $j$  for the month.

Then  $L_j$ , the average length of stay (in days) of an inpatient in department  $j$  is given by  
 $L_j = \frac{\sum d_{ij}}{n_j}$

Average cost for treating an inpatient can be estimated as follows. Inpatient service charges include charges for stay (bed and food charges), investigations, medicines and

drugs, and any procedures (see Figure 2 and Figure 3). Charges for stay, investigations, and procedures are fixed in government hospitals and hence easy to collect. However, the cost of medicines and drugs for each inpatient has to be estimated as follows. Let

$C_j$  = cost of medicines and drugs issued by the medical stores to department  $j$  in a month. (These data can be obtained from the "issue registers" and the rate contracts maintained by the medical store.)

$I_j$  = number of inpatient days in department  $j$  for the same month.

Then:

$C'_j$  =  $C_j/I_j$  is the average cost of medicines and drugs per inpatient day for department  $j$ , and

$C'_j * I_j$  = the average cost of medicines and drugs for treating an inpatient in department  $j$ .

A sample MIS report on inpatient services is given in Table III.

*Surgical procedures*

Surgical procedures are grouped into various specialties such as general surgeries, orthopedic surgeries, and so on. Government hospitals classify all the surgical

|                                       |                     |
|---------------------------------------|---------------------|
| IPD No. 235563                        | Bill No. D 025205   |
| OPD No. 1454926                       | Date: 05-07-2001    |
| Name of Patient: *****                | Ward: Male Surgical |
| Status (Staff/Individual): Individual |                     |
| From: 28-06-2001 To: 05-07-2001       |                     |

| Service ID | Services/Materials                 | Amount (Rs). |
|------------|------------------------------------|--------------|
| 000        | Registration                       | **           |
| 001        | Bed Charges                        | **           |
| 004        | Professional and Treatment Charges | **           |
| 014        | Medicines and Drugs                | **           |
| 016        | <b>Laboratory Investigations</b>   | **           |
| 018        | Radiology Investigations           | **           |
| 027        | Telephone Calls                    | **           |
| 028        | E.C.G.                             | **           |
|            | .                                  | **           |
|            | .                                  | **           |
|            | .                                  | **           |
|            | <b>Total Dues</b>                  | <b>**</b>    |

Figure 2.  
Inpatient bill

| Date     | Test ID | Test Name  | No | Amount (Rs) |
|----------|---------|--|----|-------------|
| 29-06-01 | 1005    | Complete Blood Count(HB, TC, DC, ESR)            | 1  | **          |
| 29-06-01 | 10023   | Prothrombin Time (PT)                            | 1  | **          |
| 29-06-01 | 10101   | Activated Partial Thromboplastin (APTT)          | 1  | **          |
| 29-06-01 | 10208   | Urine Routine Analysis                           | 1  | **          |
| 29-06-01 | 10575   | Creatinine                                       | 1  | **          |
| 29-06-01 | 10604   | FBS/PPBS/RBS                                     | 1  | **          |
| 30-06-01 | 10573   | Complete Lipid Profile (Cholesterol, Trigl, HDL) | 1  | **          |
|          |         | <b>Total Lab Investigations</b>                  |    | <b>**</b>   |

Figure 3.  
Laboratory investigations  
(details)



| Ward name            | Bed occupancy % | No. of patients discharged | Average length of stay (days) | Total service charge billed (Rs) |
|----------------------|-----------------|----------------------------|-------------------------------|----------------------------------|
| Ante natal care      | 10              | 3                          | 14.7                          | 2,030                            |
| ENT                  | 80              | 4                          | 3.0                           | 1,566                            |
| Female med. ward     | 50              | 10                         | 2.9                           | 2,041                            |
| Female surgical ward | 75              | 7                          | 2.6                           | 1,855                            |
| Gynac. and obst.     | 80              | 3                          | 7.0                           | 813                              |
| Emergency            | 150             | 18                         | 1.4                           | 1,705                            |
| Male med. ward       | 50              | 13                         | 4.2                           | 2,761                            |
| Male surgical ward   | 70              | 3                          | 2.7                           | 645                              |
| NICU                 | 35              | 2                          | 1.5                           | 262                              |
| Ortho ward           | 95              | 9                          | 7.0                           | 2,475                            |
| Post natal care      | 50              | 12                         | 3.7                           | 3,285                            |
| <i>Post partum</i>   | 100             | 2                          | 9.0                           | 643                              |
| Total                |                 | 89                         |                               | 20,081                           |

**Table III.**  
MIS report on inpatient  
wards at an AMC  
hospital

procedures within each specialty into two types, namely, minor and major procedures; major procedures covering a very wide range of simple to complex procedures. Each specialty has its own operating theatre (OT). OTs work as independent units with their own OT staff. OTs are major cost centers as they consume vast amounts of hospital resources and account for large overhead expenses. In return, OTs are expected to generate a substantial amount of revenues to the hospitals. However, revenue from OT services are very low in government hospitals due to their policy to offer these services at highly subsidized rates.

OT management is a critical activity in any hospital. It deals with the planning and monitoring of surgical procedures, which consists of preparing a daily schedule for each OT, managing the inventory in the OT stores, and managing the OT costs.

Preparing a daily schedule for each OT requires ensuring the availability of the consultant surgeons, anesthetists, and other OT staff. OTs account for almost 30 percent of the value of hospital supplies, and hence an efficient and effective management of OT supplies is critical to ensure the availability of materials and minimize the cost of inventory held. Managing OT costs can be achieved satisfactorily through an ABC approach, though this requires a properly designed data collection methodology. Central to the ABC methodology is the identification of activities and resources required to provide a given set of services. In the context of hospitals, OT activities consist of preparing the OT complex, pre-operative procedures on patients, anesthesia procedures, surgical procedures, post-operative patient care, and post-operative OT work (Figure 4). The methodology for estimating the OT costs using the ABC approach for general surgeries is clearly explained elsewhere (Lakhia and Ramani, 2002).

Some of the performance indicators of each OT are given below:

- Number of surgeries (minor and major) scheduled in a month.
- Number of surgeries (minor and major) performed in a month.
- Average utilization of OT per day (percent time spent on surgical procedures).
- Value of OT items consumed in a month.
- Value of OT items held in inventory for a month.

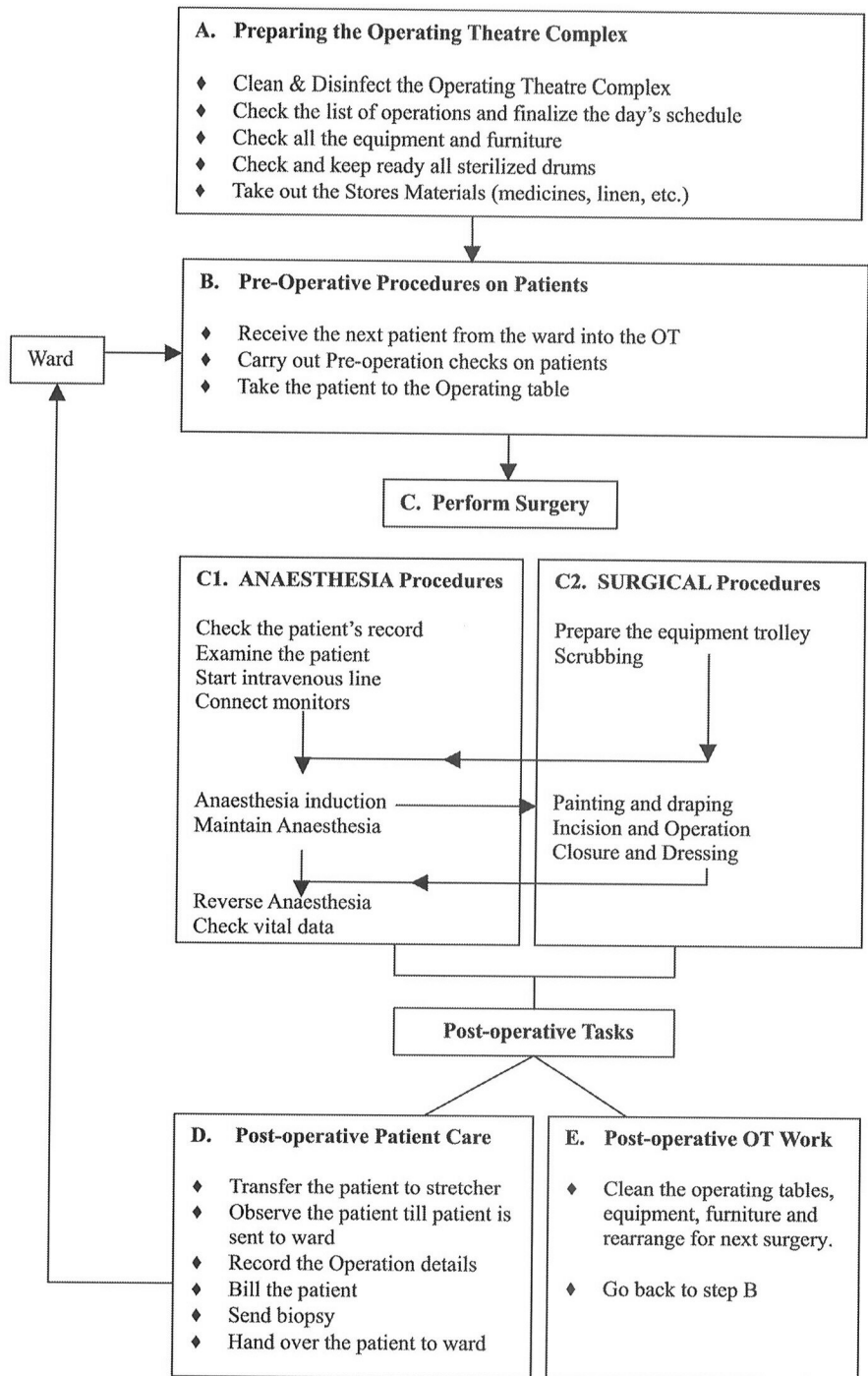


Figure 4.  
Activities in an operating theatre

- Costs of surgical procedures in a month.
- Waiting time of patients for surgery after surgery is recommended.
- Percentage of surgical patients who came back due to unsatisfactory recovery.

All the above indicators can be easily estimated and are therefore not described here.

### *Investigation services*

Investigations assist the doctors in the diagnosis of ailments, and form a critical part of patient care. Investigations are classified under laboratory and imaging/radiology investigations. Laboratory investigations consist of sample collection and analysis by various laboratories, such as biochemistry, clinical pathology, microbiology, etc. Each laboratory performs a large number of investigations every day. Laboratories collect the samples before noon and give their investigation reports by the evening. Radiology investigations include x-rays, sonography, and other imaging services. Reports of radiology investigations are usually available within a few hours.

Different clinical departments order different types of lab and radiology tests (biochemistry tests, microbiology tests, simple x-rays, etc.) based on the nature of the illness they treat. Labs account for almost 30 percent of the total value of purchases of hospital supplies. Labs and radiology departments also have expensive resources such as auto-analyzers, CATSCAN, etc. for performing various investigations. An estimate of the number of tests performed by each investigation department would help the hospital authorities to understand the load on the investigation departments, their utilization of resources and the level of support offered by the investigation departments to the clinical departments. An estimate of the costs of investigation services vs the revenue from such services would provide useful insights into the efficiency of the performance of investigation departments.

Some of the performance indicators for investigation departments are:

- Average number of tests performed by investigation department  $i$  for the clinical department  $j$  in a month (outpatients vs inpatient services).
- Cost of materials consumed by the investigation department  $i$  for all the tests conducted in a month (outpatients vs inpatient services).
- Revenue earned by each laboratory department  $i$  from the tests ordered by each clinical department (outpatients vs inpatient services) in a month.

Let us define the following terms:

$T_{ij}^0$  = number of tests performed by investigation department  $i$  for treating the outpatients of the clinical department  $j$  per month;

$T_{ij}^1$  = number of tests performed by investigation department  $i$  for treating the inpatients of the clinical department  $j$  per week; and

$$N_{ij} = T_{ij}^0 + T_{ij}^1.$$

Then the average number of tests per month performed by investigation department  $i$  for treating the outpatients of the clinical department  $j = T_{ij}^0/N_{ij}$ . Similarly we can estimate the load from inpatient clinics and therefore the number of tests (inpatients + outpatients) performed by each investigation department for each clinical department.

Cost of materials consumed can be estimated from the data kept in the Issue Registers maintained by the medical store. Revenue earnings by each investigation

department can be computed from the number of tests performed and the fixed charges for each test.

#### *Administrative support services*

Several administrative departments support the delivery of hospital services. Of particular interest to us is the government medical store, which is responsible for managing the inventory of hospital supplies such as medicines and drugs, surgical items, lab chemicals, x-ray plates, spare parts for maintenance etc. Hospital supplies account for 80-90 percent of the total variable expenses incurred by the hospitals. Effective and efficient management of hospital supplies is therefore critical to managing the costs of medical care. The existing processes and procedures followed by the government are very unsatisfactory, as explained earlier. We have recommended a re-engineered material management process for the government medical store in order to provide meaningful support to the hospitals. The proposed re-engineered system is aimed at integrating the purchase, receipt, issue, and payment activities into a value added process. The objective of the proposed process is to plan and monitor the consumption of stores materials by each clinical ward, OT, laboratory, and the radiology departments. We would be discussing the management of hospital supplies and other administrative support services in detail in another paper.

#### *MIS implementation*

Government hospitals do record data in various registers, in order to generate statutory reports. However, they do not organize the data in a meaningful way to support decision making. Details of outpatient services are available only in the OPD booklets that remain with the outpatients. Data on inpatient services are available in the inpatient booklets maintained either by the sister-in-charge for the patients currently undergoing treatments in her ward or by the medical records department for the patients already discharged. The daily registers maintained by each investigation department help them to dispatch the reports of investigations to the respective wards and/or the medical records department. The medical store maintains ledgers for purchase orders placed with the vendors and materials issued to the hospital against indents. Receipt ledgers are maintained by the stores, while payments to the vendors are made by the finance department in the government.

It is clear from the above discussions that the success of any MIS to support decision making in the delivery of hospital services depends critically on the success of data entry/capture. Data should be captured at the places where they are generated. Payment counters, clinical wards, OTs, investigation departments, and medical stores are the major data sources in a hospital. All the data for outpatient billing can be captured at the OPD payment counters, where outpatients pay for all services before availing any service (Figure 1). Data for inpatient billing have to be captured and compiled from several places such as clinical wards, investigation departments, medical stores, operating theatres and so on at the time of patient discharge (Figure 2). It is very important to realize that the database required to generate inpatient and outpatient bills would suffice most of the data requirements to generate MIS reports for planning and monitoring healthcare services.

In any large government system, the decision to implement an MIS is normally made at the top; however, its implementation would require the cooperation of each and every officer in the field. Most often, new initiatives and changes proposed at the top without appropriate preparation in the field do not get implemented. To ensure that

our proposed MIS for government hospitals was implemented, we took five important steps:

- (1) We sold the need, purpose, and the overall design of the MIS to the top management of the AMC.
- (2) We sought and gained the acceptance of the AMC hospital administrators for the MIS reports suggested.
- (3) We tested whether the MIS could be implemented, particularly by assessing whether the proposed data could be collected and at what cost in an AMC hospital.
- (4) We trained the hospital superintendents and the heads of various departments in AMC hospitals to motivate them to improve the delivery of their services by relying on the MIS for planning and monitoring.
- (5) We allayed the fears of Class III (nurses, technicians, admin. staff) and Class IV (sweepers, cleaners, etc.) employees regarding loss of jobs and/or increased work load from the proposed MIS.

To sell the proposed MIS, we organized a presentation to the top management of AMC, namely, the Mayor, Deputy Mayor, Chairman of Hospital Services, Municipal Commissioner, Deputy Municipal Commissioner (Finance) and a group of influential elected representatives of the corporation. Our presentation focussed on our approach and the overall design of the MIS, providing illustrative examples. We discussed computerization in terms of costs and benefits and made a demonstration using data collected from an AMC hospital for three months. The AMC Mayor and the Chairman of Hospital Services were worried about the effort that would be needed to implement a new reporting system and the need for more staff even though the existing elaborate records did not produce MIS reports. We treated these objections as constraints in designing the proposed system. The active interest of the Municipal Commissioner (the most senior civil servant in the Corporation) helped a great deal to ensure the acceptance of the system.

To gain acceptance from the hospital administrators, we conducted a workshop attended by all the superintendents and the heads of various departments of AMC hospitals. It was difficult to get them to specify their information needs or to propose a report format. It was much easier to get them to react to a prototype. We therefore discussed several prototype MIS reports at length and asked for their suggestions and/or modifications. These were debated extensively and accepted or rejected by the group. We then prepared a revised version of the MIS reports, meeting all their information needs.

To test whether the system could be implemented, we carried out a field test in all the three hospitals by collecting data for three months and using the proposed forms to generate the MIS reports. The data collected were processed on the hospital computer system to generate the proposed reports. During the data-collection period, we held training workshops for the hospital staff to explain the report formats and the importance of each element of data in detail.

To us, implementation of an MIS means its use and not merely its installation. Very often, MISs are installed but not used. Unless administrators want to improve their department's functioning and know and understand ways to do it, a printed report will not help. The Municipal Commissioner was very keen that implementation of the proposed MIS be intimately linked with a training program to train the hospital staff in the preparation of various aspects. We designed such a training program to emphasize

information systems, computers, and the use of data to support planning and monitoring of hospital services, inventory, cost control, and so forth.

We took special care to allay the fears of the lower level employees on job loss or increased workload from MIS. We found that the primary concerns of most of the heads of departments were that already overloaded personnel would be assigned more tasks if the MIS were to be implemented. The Class III group of employees, consisting of nurses, technicians (in labs and X-ray units) and the admin. staff, who are responsible for data collection, compilation, and entry into the computers for MIS, processing were afraid of additional workload. Class IV employees, consisting of ward assistants, sweepers, and cleaners, were afraid of job loss. We have managed to take care of these concerns through extensive negotiations with the staff union, followed by computer training for hospital staff, and installing user friendly data entry software in each of the data sources. We held separate meetings with all the Class III and Class IV staff. We listened to all their concerns, noted them down, and helped them understand how computerization would add value to their work, and not replace them.

### Conclusions

In a situation where the performance assessment of government hospitals is almost non-existent, our MIS, though generating estimates only for a limited set of performance indicators, is proving to be a useful tool to plan and monitor the delivery of hospital services efficiently and effectively.

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### Further reading

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