

PROBLEM STATEMENT

Healthcare Service – Inventory Management

Medical Tourism to India is becoming prominent due to its growing contribution to Indian GDP. As a result new players are entering the market. However, like any other industry, the cost of providing healthcare services is also increasing day by day.

To reduce the operational cost, healthcare professionals and researchers are constantly working on. To accomplish the same, in many a case simulation has been found to be very effective and hence has been proven to have potential acceptance in healthcare services.

The various fluctuating parameters that are critical to a hospital are flow of patients, bed occupancy (LoS - length of stay), waiting times to get an appointment, waiting time to consult a doctor, and apart from sudden demand of healthcare services due to epidemic, natural calamities, road and other accidents, etc. The primary mission of healthcare institutions is to provide economical and quality service to the patients.

The current problem is managing the uncertainty of demand of medicines and lead time to receive medicines from suppliers.

Simulation empowers the hospital management to evaluate the consequence of uncertainty in the above mentioned parameters without hampering the normal operations or engaging any of its resources.

Let us consider the case of Thomson and Cook Hospital.

Currently the hospital is facing challenges in managing its stock of medicines. It has three categories of medicines namely Type A (life saving or emergency medicines), Type B (ordinary medicines) and Type C (special and expensive medicines).

The below table summarizes the average annual demand, unit price, lead time to procure, and other related information.

As per their available data (a representative data has been given for your computation / estimation) of last 3 years and practice the below information is available,

1. The 3 years Average Annual Demand of these 3 kinds of medicines
2. The 3 years Average unit price of these 3 kinds of medicines (the price fluctuates every year based on annual CPI)
3. Average Lead time and its standard deviation to receive medicines remained same in all these years
4. The 3 years average ordering cost for these 3 kinds of medicines is based on internal cost of manpower and IT system (the price fluctuates every year based on annual CPI)
5. Right now the medicine-stores department (without any data scientist) has come out with a value for Safety Stock amount as given in the table based on last 3 years data

	Type A	Type B	Type C
Average Annual Demand (in Unit) based on earlier consumption	31200	124805	20802
Average Unit Price (INR) in last 3 yrs	200	80	1200
Average Lead Time (Days)	10	3	20
Standard Deviation of Lead Time (Days)	3	0.5	6.5
Constant Safety Stock (in Unit) ; based on criticality and price	854.8	2403.2	363.6
Purchasing (from placing order till receive and accept medicine) cost per unit (INR)	4.2	2.8	8.3

In addition to above table, the holding cost / inventory carrying cost for all the types of medicines is 10 percent of unit price per year (considering expiry, storage, refrigeration, security, damage, etc.).

Demand is based on number of in-door patients, severity of condition of the indoor patients, consulting doctor treating the admitted patients and right now it has been estimated based on 3 years monthly consumption data.

The issue of medicines shall be First in First out process keeping in mind the expiry date of the medicines.

- 1. Do you find maintaining a constant safety stock to be justifiable? If no, why? State reasons to support your opinion. To make it data analytics driven - what should be your approach?**
- 2. Please forecast the demand of medicine Type A for next 4 months.**
- 3. For “Type A” medicine, calculate i) EOQ ii) The number of orders per year iii) Reorder level iv) The total annual ordering and carrying costs v) Maximum Inventory level for “Type A” medicine to help Thomson and Cook hospital manage its inventory optimally.**

The hospital is planning to follow FMEA (Failure Mode and Effective Analysis) as its risk mitigation plan and in the event of any preferred vendor (effectiveness considering quality, lead time & cost) not able to supply the medicine on time or it expresses its inability to supply for any reason, then another set of listed vendors will be given with the order for a substitute medicine and these orders will be at a much higher price mostly having a fixed lead time.

The table below summarizes requisite information for these vendors who are given order in emergency:

	Type A	Type B	Type C
Lead Time (Days)	2	1	4
Standard Deviation of Lead Time (Days)	0	0	0
Constant Safety Stock (in Unit)	Not Applicable	Not Applicable	Not Applicable
Average Purchasing cost per unit	6.8	4.2	14.4

The out-of-stock situation for one unit of Type A (Life Saving and Emergency) medicine is a probable loss of business of INR 20000 on an average which gives 20 % net profit, whereas the same for a Type C (Special or Expensive) medicine is a probable loss of business of INR 60000 on an average which gives 18 % net profit.

You are a kind of hospital manager who is a higher risk taker. Assume you would like to maintain a less amount of safety stock to reduce inventory carrying cost and manage the out-of-stock situation by ordering medicines from vendors at higher cost in emergency. Please try to simulate the scenarios and investigate/ estimate the trade-off between Risk vs. Money. Implement in case of Type A (emergency) medicines.

Do you feel you need more information or data? If so, you may assume and proceed with your estimation stating the necessary assumption too.