

## Cost analysis of clinical chemistry examinations at government run tertiary care center

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### **Abstract**

**Objectives:** The objectives of the study are to collect data related to expenditure on various items and services used for various examinations and estimate cost per examination.

**Material & Method:** In present study, cost per test is calculated for seven parameters i.e glucose, alanine transaminase, direct bilirubin, total bilirubin, creatinine, urea and total protein. It is a retrospective study, in which all data for consumables are taken from invoices and purchase registers and information regarding salary of the staff is collected from clerical department. All data are then classified in to variable and fixed costs. Total cost per test is calculated for each test by summing up its variable and fixed costs.

**Result & Discussion:** On an average, an examination at laboratory under study costs 5 to 8 rupees per test. On comparing the cost by replacing regular staff by contractual staff it is found that there is no significant change in the cost. Use of automated analyzers is costing 36% of that done by semi automated analyzers. There is approximately Rs 30000 saving in cost due to in house reagent, a marginal benefit to the laboratory management.

**Conclusion:** Purchase of good quality automated analyzers results in significant decrease in cost of examinations. Electricity, AC, buildings and staff are major contribution to cost of examination and management must pay attention to them to improve cost-effectiveness of the laboratory.

**Keywords:** Cost analysis, cost per test.

### **1. Introduction**

In present era, undoubtedly financial management is an important component of a clinical laboratory management to provide quality services at low cost[2]. It is also important for government hospitals where fiscal management helps in taking decisions and help to give quality services under resource limitations. The study aims at finding cost per test for seven parameters i.e, Glucose, alanine transaminase, total protein, urea, total and direct bilirubin and creatinine.

#### **1.1 Various costs**

- 1. Direct costs:** labor cost, reagents, pipettes, tips, quality control material, equipment etc.
- 2. Indirect costs:** accommodation facilities, office supplies, external QC testing, equipment depreciation, maintenance contracts etc.

**3. Fixed cost:** Cost which does not change with the change in test volume. e.g. Capital asset expenditure i.e analytical instrument [1].

**4. Variable cost:** Cost which increases with increase in volume of test. e.g. reagents, disposable supplies [1].

**5. Semi fixed:** Costs that change in a stepwise manner. For example, if workload is increased, new staff needs to be recruited or an instrument needs to be purchased. [2]

**6. Semi variable:** Combination of fixed and variable costs. e.g. Electricity consumption, AC etc. These costs remain stable over a period of time, and may change with increase in workload [2].

**Table 1: Examples of Fixed and variable consumables**

	Pre analytical	Analytical	Post analytical	Miscellaneous
Fixed	Computers, Centrifuge	Erba XL 640, Computer, UPS, RIQAS	Printer, Computer	Refrigerator
Variable	Syringes, Needle, Vaccutte, Ependroff cups, Marker pen, Tips, Pipettes	Reagents, Quality controls, Calibrators, Wash solution, Reagent bottles	A4 size Paper	Electricity

### 1.2 Calculating Costs for Tests

Full test costing includes the following three major elements of cost:

- A. Fixed labor costs;
- B. Fixed consumables (materials) costs; and
- C. Variable consumables (materials) costs.

Costs of consumables should be calculated based on actual quantities used and not that defined in the test procedure. These actual costs are more reflective of true operations and allow for the following variables[1]:

1. Instrument start-up and shut-down;
2. Stability and shelf life of reagents;
3. Package size; and
4. Wastage.

Cost of all consumables are accumulated and summed up and divided by the total no. of investigations in which they are used (as per their usage cost are allocated) to get cost per test.

### 1.3 Benefits of Cost analysis

1. For assessing ongoing processes and help in finding a problem and solve it.[3].
2. To decide that a test should be performed in house or referred to other laboratory [1].
3. Identification of area of faulty procedures, or reagents or methods to reduced cost and help in giving quality services at low cost

## 2. Materials and methods

- Clinical Biochemistry Laboratory, New Civil Hospital Surat, Gujarat, is the object of study in financial year 2013-2014. The total investigations performed in one year is around 6,50,000.
  - Collection of data related to cost incurred for human resources
1. Salaries of the staff are collected from office of the dean and medical superintendent and only the staffs involved in result production is considered for the study. As the government regular staffs are given yearly increments, such cost was calculated using salary received during study period.
  2. The total human resource cost is divided by the total number of investigations for obtaining cost per test allocated to human resources.

- Collection of data related to costs incurred for material resources and then classified into fixed and variable cost :

1. Data for material resources are collected from purchase registers and invoices.
2. Since laboratory does not get separate electricity bill, so an indirect method is used to calculate the electricity bill from reliable resources. Electricity bill is calculated using torrent online consumption calculator using watts of the equipment and approximate time of its use in hours per day. And then unit consumption for 1 month is multiplied by the cost per unit to get the total electricity cost for a equipment. Sum of electricity cost of all equipments give the total bill for a month. It is multiplied by 12 to get electricity cost for 1 year. This is then divided by total no. of investigations performed in 1 year to get cost per test attributed to electricity. Cost per unit is 380 paise.
3. Sum of all the data is then divided by the total number of investigations to get cost per test allocated to the material resources.

Cost per test allocated to human and cost per test allocated to material resources are summed up to get total cost per test. All data are sorted in excel sheet and pie charts are drawn to show the component cost for each test.

The table below shows that Glucose, total bilirubin, direct bilirubin, creatinine, alanine transaminase, total protein and urea constitute around 60 % of total tests performed in the laboratory. Hence, they were selected for analysis.

**Table 2: Yearly workload of various tests at New Civil Hospital Services Laboratory Services**

Examinations	Number of investigations
ALT	69913
Bilirubin Direct	68541
Bilirubin Total	68734
Creatinine	78886
Glucose	77975
Total Protein	28992
Urea	11881
Total investigations	404922
Total investigations including all other examinations	654901

### 3. Results and discussion

Costs were primarily calculated for examinations done using Erba XL 640 for a period from March 2013 to Feb 2014 at Clinical biochemistry laboratory, New Civil Hospital Surat.

**Table 3: Cost per test for various parameters**

Examination	Cost per test in rupees
Alanine Transaminase	6.4
Direct Bilirubin	5.3
Total Bilirubin	5.3
Creatinine	5.3
Glucose	8.7
Total Protein	5.3

**Table 4: Comparison of cost per test (in rupees) between contractual and regular staff**

Examination	Contractual	Regular
ALT	6.2	6.4
Direct Bilirubin	5.1	5.3
Total Bilirubin	5.1	5.3
Creatinine	5.1	5.3
Glucose	8.5	8.7
Total Protein	5.1	5.3
Urea	7.4	7.6

The laboratory has some of the regular government employee while many others are contractual staff. In general, contractual staff has lower salary than the regular government employee. An analysis was performed to see if there is any significant cost saving by hypothetically replacing all regular government employees with contractual staff. There is no significant change in the cost of replacing regular staff by contractual staff.

**Table 5: Difference in cost per test between kit and in house reagents**

Examination	Kit			In house reagents		Difference
	Total test	Cost per test	Total cost in 1 year	Cost per test	Total cost in 1 year	
Direct Bilirubin	68541	5.4	372985	5.3	362596	
Total Bilirubin	68734	5.4	374018	5.3	366476	
Creatinine	78886	5.4	423706	5.3	416810	
Total Protein	28992	5.5	158389	5.3	152762	
Total cost of all tests in 1 year			1329098		1298644	30454

Table shows hypothetical scenario where all in-house reagents were replaced with ready to use kits.

There is approximately Rs.30000 saving in cost due to in house reagent, a marginal benefit to the laboratory management.

**Table 6: Comparison of cost per test (in rupees) between Erba XL 640 automated analyzer and Erba chem semi automated analyzer**

Examination	Erba XL 640	Erba chem semi autoautomated
ALT	6.4	17.1
Direct Bilirubin	5.3	14.3
Total Bilirubin	5.3	14.5
Creatinine	5.3	14.3
Glucose	8.7	24.0

Above analysis data show that using automated analyzer cost per test is 36% of that done by semi automated analyzer.

The above analysis assumes that, due to high workload, semi automated analysis cannot complete all the examinations. And laboratory does only very important tests only. Moreover there is increased reagent consumption due to higher volumes required. Output of technicians also decreases in terms of number of tests a technician can do. Even buildings and AC have significant increase in cost per test.

Thus, automation is single most cost effective solutions for a modern day, high volume, tertiary care laboratories.

### 4. Discussion

From the cost analysis done following points can be concluded:

1. Generally for any test parameter, reagent cost is considered more important and it is the most focused part but it can be concluded from the study that it is not so, reagent cost becomes minor if automation exist in the laboratory.
2. While, focus is on equipments and reagent, actually building and electricity are major contributors to cost per test. Efficient use of space and electricity is more important financially than equipments and reagents in clinical chemistry laboratory.
3. In urea cost analysis, it is observed that cost of calibration, repeats and wastage contributes to 17% of the total cost per test. On analysis of such major contribution, it was found that reagent instability resulting in reagent wastage is the important cause for such higher contribution. So on the basis of the cause, improvement can be done in reagent policies so that reagent stability can be increased or reagent can be replaced with a reagent having better stability.

4. In glucose cost analysis, it is found that vacuttes cost contributes 36.7% of the total cost per glucose test performed. For decreasing the cost following steps can be taken:

Rapid transport of samples and prompt centrifugation of serum tubes and measurement of glucose in serum within one hour of collection. This removes need for fluoride tube and its cost.

5. Laboratories must switch to automation as early as possible. It is a win-win situation in terms of quality and cost.

## 5. Limitations of the Study

Allocation of cost to human resources cannot be done precisely in the study because of increment given to staff every year. This will make change in cost per test every year.

Electricity cost is calculated with the help of torrent online bill calculator. Actual bill for laboratory is not available.

Actual data for building constructions were not available and approximated cost for construction, maintenance were taken from public works department of the hospital.

## References

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