

## RESEARCH ARTICLE

### “A ROBUST METHOD FOR REDUCING SAMPLE RETRIEVAL TAT IN CLINICAL LABORATORY SETUP AT ZERO ADDED INVESTMENT.”

Anurag Yadav<sup>1</sup>, Ramlingareddy<sup>2</sup>, Avinash SS<sup>3</sup>, Malathi M.<sup>4</sup>

<sup>1</sup>Assistant professor, Department of Biochemistry, MNR Medical College & Hospital, Sangareddy, Telangana, India

<sup>2</sup>Associate Professor, Department of Biochemistry, SSIMS & RC, Davangere, Karnataka

<sup>3</sup>Professor & HOD, Department of Biochemistry, Father Muller Medical College, Mangalore, Karnataka, India

<sup>4</sup>Professor, Department of Biochemistry, Father Muller Medical College, Mangalore, Karnataka, India,

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**ABSTRACT: Background:** The concept of Total Laboratory Automation (TLA) is shifting towards the automation in individual process i.e., Task Targeted automation (TTA). Sample storage is one of the key areas in the Total Testing Process (TTP), hence we developed a robust method to reduce the TAT for blood sample retrieval in clinical biochemistry laboratory with zero added investment. We compared the sample retrieval time (TAT) improvement in sample retrieval with the old conventional and the new method of sample storage.

**Material and method:** study was conducted at a medium-large scale lab with average sample of 1000-1200 per day. The blood sample vacutainers are stored in the refrigerator at controlled temperature for the duration of 48hrs as the lab policy. We requested the technicians to retrieve 10 patient samples from the storage for the duration of 5 days, with different person allotted each day. The samples for day were stored and retrieved the requested sample by conventional & new method. **Result:** our new method has shown a good improvement in the TAT for the retrieval of the stored blood sample for the retesting or the added parameter for testing on request. The conventional method had an average time to identify and retrieve sample was 9.2mins, which was significantly decreased to 1.4mins with the new method of sample storage and retrieval system.

**Conclusion:** Study emphasis this procedure / process will help the small and medium scale laboratories in having a robust method of sample storage and retrieval at a very short TAT with a minimal or no extra investment.

**KEYWORDS:** Total Testing Process, Total Laboratory Automation, clinical Biochemistry, Turnaround time (TAT).

#### Corresponding Author:

Dr Anurag Yadav,

MBBS, MD Biochemistry, Six Sigma Black Belt, Diploma in Diabetology.

Assistant Professor & Lab physician, Department of Biochemistry, MNR Medical College & Hospital, Fasalwadi, Sangareddy, Telangana, India



## **INTRODUCTION:**

Clinical laboratories have rapidly evolved since the 1990s, mainly driven by technological advances that focus on automation.<sup>[1]</sup> One of the ideas for automation in laboratory is desire to reduce the FTE's and manual errors in patient health care services. The concept of Total Laboratory Automation (TLA) is shifting towards the automation in individual process i.e., Task Targeted automation (TTA); pre-analytical, analytical & post-analytical area of the laboratory focusing on market demand.<sup>[2]</sup> Justification for an automation investment is typically based on a projected ability to reduce labor requirements or to increase capacity to handle more sample volume with fewer FTE's.<sup>[3-6]</sup>

Sample storage in the laboratory is a very precious step and tedious procedure. As per ISO 15189 standards, laboratory shall have a documented procedure for identification, collection, retention, indexing, access, storage, maintenance and safe disposal of clinical samples. The laboratory shall define the length of time clinical samples are to be retained. Retention time shall be defined by the nature of the sample, the examination and any applicable requirements.<sup>[7,8]</sup>

The tracking of the sample and managing the storage is a important aspect as the other process in the laboratory such as sample transport and the analysis of biological specimens.<sup>[9-13]</sup> With growing technologies, automation in every step of laboratory process has helped to reduce errors significantly, but it is difficult to catch this technology with the restriction of budget at the small-medium scale laboratory, hence requirement of cost-effective methods for solving these ubiquitous problems is need of time.<sup>[14-18]</sup> We tried to make one step towards the same and came up with the idea.

A routine laboratory will have a computer and the barcode scanner as a normal requirement for the normal smooth functioning of the processes for identifying the work flow of the sample and the time

stamp. We identified a method to reduce the TAT for sample retrieval and tractability of each stored blood samples at nil cost or least investment.

**Objective:** Develop a method to reduce the TAT in retrieving the stored blood sample and compare the effectiveness with the conventional method followed.

## **MATERIAL METHODS:**

Study is conducted at tertiary care hospital attached laboratory biochemistry section with the sample load of 1000-1200 blood samples per day. The laboratory being an NABL accredited, sample storage and integrity of each sample for repeatability or retesting the sample when required for better patient care is mandate and good practice.

**Storage:** Sample racks were used with each rack having capacity to hold 100 blood vacutainers, and these are placed in temperature maintained 2-8°C refrigerator dedicated to biochemistry section for the duration of 48hrs as per the laboratory policy.<sup>[19]</sup>

**Conventional method:** The samples are placed in each rack and are labelled with time of analysis on the analysers and stored in refrigerator; namely as 12-2pm, 2-4pm for respective date etc., When requested for retrieval of stored sample, technician has to search the time slot of that patient ID on analyser and then find the required vacutainer among 100s of sample in the rack.

**New method:** Barcode of each sample are scanned (registered on Excel) and stored in the racks sequentially time to time. Each rack represents the column in excel, hence each column in excel will have sequence data of specimen stored in respective rack. The naming of sample racks was given according to the column name on excel. These racks are stored in refrigerator or the temperature maintained cooler for respective date. When requested for the retrieval of stored sample, the patient ID is searched on registered excel for the respective date, and because of which technician was able to identify the rack and the position of the

individual patient ID position in the rack without great effort.

Ten patient sample ID number were randomly selected from the hospital information system and requested technician to retrieve the blood sample from the storage; by conventional method which was practised & new method of sample retrieving from storage by same person for the day. This was performed for next 5 days with different technicians. The total time taken by the technician from the time of request of the sample till all samples were retrieved was noted. This process was conducted during the peak hours of the day 8-11am.

Statistical analysis: The data was collected in proforma and entered in excel sheet. The collected data was summarised as mean, standard deviation, frequency. The mean of average time required to retrieve the samples by both methods was calculated and student's t-test was used to assess the significance between the means of methods. The p-value <.05 was considered statistically significant. Statistical package used is SPSS v23 institutional licence.

**RESULT:**

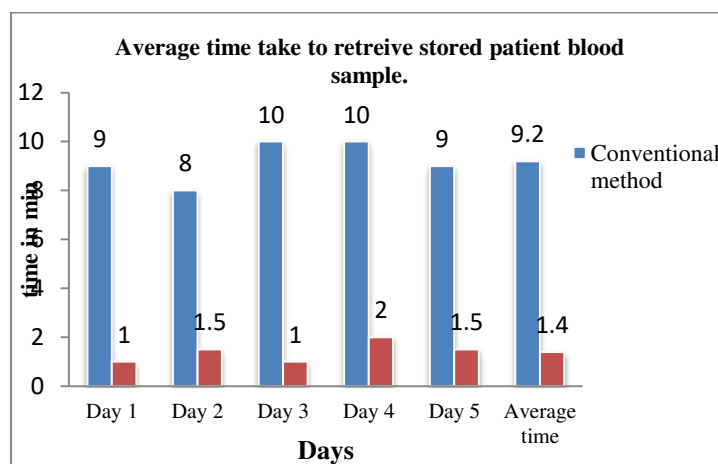
Total of 5 technicians were subjected for the retrieval of the blood specimen from the storage for the span of 5 days. Each day a different technician was used. The total number of samples in each day storage was ranged from 650-800 sample tubes in the section of biochemistry.

On requesting a particular patients ID sample, the technician has to scan all the samples stored on that particular date to find the requested sample. On an average, the time taken by the technicians to retrieve one blood sample from the storage across the 5 days was found to be 9.2 mins by the conventional method, which was followed at the lab. (Table 1)

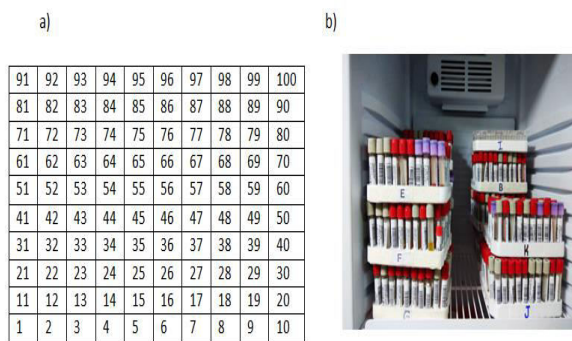
**Table 1: Showing the average time taken by the technicians in retrieval of patient blood specimen from storage, t-test was analyzed to compare the means.**

Sample retrieval time	Old method (average time in mins per sample)	New method (Average time in mins per sample)	p-value
Day 1	9	1	<0.05**
Day 2	8	1.5	<0.05**
Day 3	10	1	<0.05**
Day 4	10	2	<0.05**
Day 5	9	1.5	<0.05**
Average time	9.2	1.4	<0.05**

*Old method- conventional method practised at the laboratory; New method- the new process of sample storage. \*p-value <0.05 significant, \*\*Highly significant (HS).*



**Figure 1: Showing the average time taken by the new method and conventional method of sample retrieval in the clinical biochemistry section over the period of 5 days**



**Figure 2:** a) Showing the numbering of sample stored in each rack; b) Showing the labelling and storage of sample in refrigerator.

But with the new protocol method, the sample was traced or retrieved from storage on average of 1.4 mins for each sample. There was significant reduction in the time to retrieve the sample from the storage by following the new method of storing the samples in the racks without much hassle. ( $p < 0.05$ ) The average time taken by the technicians following the two different methods is presented in table 1. The pattern of the sample storage in the refrigerator after scanning the barcode is shown in the (Figure 1 and 2).

**DISCUSSION:**

The clinical laboratories need a continuous, high quality customer service in order for them to keep their high-quality serving. These requirements are becoming increasingly questionable because of cost apprehensions.<sup>[12,20-22]</sup> Reanalysis of the sample or the repeat analysis is a very common practice in the medical laboratory.<sup>[23]</sup> The reanalysis of sample is routinely done on request from clinician, or the lab consultant to cross verify the result, or as part of quality check in the laboratory and also during the accreditation process the assessor do ask for retrieval of the previous day specimen to reanalyse. While managing a limited labour force, automation strives to handle growing workload demands, eliminate mistakes, and improve laboratory performance. Improving laboratory activities needs more than simply purchasing technologically advanced

equipment; it also necessitates an organised strategy that combines best practises in lean work processes, IT support, and professional staff.<sup>[24-26]</sup>

In present study, we have used the available work flow to make it feasible for tracking stored blood sample. As the laboratory gets the bar-coded blood samples for the analysis, hence samples can easily be stored in the refrigerator in the sample racks according to date wise after scanning it under the barcode scanner in computer. Hence when the sample is asked for the retesting by the patient treating physician, it hardly takes a minute to identify the sample from the stored rack and retrieve. The average time taken by the technicians across the days for retrieval of stored sample showed a significant improvement in TAT. This has a positive impact on early analyzing the sample on request & helping to deliver the early treatment to patient based on the test results.

Random assignment of the sample for the storage is out of the question; as the laboratory receives the request for the reanalysis of the sample or addition of the parameters in same blood specimen which has been received by the laboratory. With this new method the sample retrieval has become hassle free and the accuracy with which the sample can be retrieved is improved. This process also helps to track / document all the blood sample ID's which are discarded by the laboratory. This procedure saves the time for searching the sample and traceable to exact position of the given sample ID when required. This has served to reduce the TAT for sample retrieve for the retesting on request from the clinicians or as and when required by the lab to retest in specimen.

The clinical biochemistry laboratory's output is heavily influenced by efficiency and efficacy of such process. Laboratory-wide practices must be applied in order to reap actual advantages. At the time of implementing laboratory automation, the primary aim was to boost efficiency while also maintaining and, ideally, improving service performance in terms of TAT for key tests and our capacity to handle a larger

test repertory on a 24/7 basis.<sup>[27,28]</sup> Automation is boon for the modern laboratories, in reduction of the errors and providing better laboratory health care services to society.<sup>[12,26]</sup> Currently Automation is focusing on the task based automation with availability of options.<sup>[11,29,30]</sup> Here in our study, we mimicked the automation steps with minimal investment and also no added cost for the improvement in the sample retrieval method for reanalysis or retesting of particular sample.

### **CONCLUSION:**

Study emphasis this new procedure / process will help the small and medium scale laboratories in having a robust method of sample storage and retrieval at a very short TAT with a minimal or no extra investment. This will decrease cost through more efficient utilization of FTE's. As the automated post analytical modules fetch a huge sum of investment from these small and medium scale laboratories. Automations and technology catch up, but is slow to catch on. Hence, we suggest this procedure for routine practice with the modifications as required by the laboratory at their own setup.

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