Research Article

Study of determination of laboratory turnaround time in tertiary care hospital in India

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ABSTRACT

Turnaround time (TAT) is commonly defined as the time from when a test is ordered until the result is reported. TAT is often considered the most significant measure of a laboratory's service and is used by many clinicians to judge its quality. Timely reporting of laboratory test results is now considered an important aspect of the services provided by the clinical laboratory. It has also been shown that outcomes in certain situations such as operation theaters and in emergency departments have been affected by timely reporting of lab tests results. Rapid laboratory turnaround times are important both from a medical and commercial point of view. The study was conducted from 1 April 2013 to 31 May 2013. Out of total 232 samples, 183 samples (78.88%) were taken for analysis. 100 (54.65%) samples were within TAT time and 83 (45.35 %) samples were delayed. Out of total 83 samples which were delayed, 48 (57.83%) samples had TAT between 60 minutes to 90 minutes, 22 (26.51%) samples had TAT between 90 minutes to 120 minutes, 9 (10.84%) samples had TAT between 120 minutes to 180 minutes, and 4 (4.82%) samples had TAT over 180 minutes. Average time between sample collection and lab reach was observed to be 15 min. 38 sec. Transport delay was observed. Instrumentation failure was observed in biochemistry - 2 times and thyroid - 1 time. Hence this study aims to evaluate the delay and reason of delay of turnaround time (TAT) of stat tests in section of clinical chemistry of the clinical laboratory.

Keywords: Turnaround time (TAT), Transport delay, Quality of care, Laboratory services

INTRODUCTION

The laboratory turnaround time can be defined differently according to the test type (stat vs. routine), analyte, and institution. It is commonly defined as the time from when a test is ordered until the result is reported.¹ The total TAT for laboratory assays includes the entire interval from ordering of the test to the clinician's awareness of the result (i.e., "brain-to-brain"). It consists of the intervals from order placement to specimen collection, as well as the time necessary for transport to the laboratory, accessioning in the laboratory, centrifugation, aliquoting, additional preanalytic steps if necessary, transport times within and between laboratories, analysis time, the time after completion of analysis until result verification, and

the time it takes for the clinical team to be informed of the result.² The effects of TAT have been studied to a high extent, with correlations being drawn between emergency department treatment and length of stay.³ As a result, TAT is often considered the most significant measure of a laboratory's service and is used by many clinicians to judge its quality. Along with accuracy and reliability, timely reporting of laboratory test results is now considered an important aspect of the services provided by the clinical laboratory. Whether or not, faster turnaround time can make any medical difference, patients and their physicians want reports as rapidly as possible. It has also been shown that outcomes in certain situations such as operation theaters and in emergency departments have been affected by timely reporting of lab

tests results.⁴ Hence, rapid laboratory turnaround times is important both from a medical and commercial point of view. The study was conducted to evaluate the delay and reasons of delay of turnaround time (TAT) of stat tests in the section of clinical chemistry of the clinical laboratory.

Aims and objectives

1. To study the laboratory turnaround time
2. To evaluate delay of turnaround time
3. To find out reasons for delay in turnaround time
4. To suggest measures to reduce turnaround time, if possible

METHODS

Study location

This study is conducted at laboratory of Yashoda hospital, Secunderabad, which is a tertiary level superspecialty hospital. The hospital laboratory consists of hematology, biochemistry, microbiology and cytology test.

Inclusion criteria

1. All the tests advised and conducted as advised by consultants in Yashoda hospital
2. Routine lab tests having standard turnaround time

Exclusion criteria

1. Samples having abnormal results
2. Rare tests which are not having standard turnaround time
3. Samples which are part of master health check ups
4. Oncology samples which are checked by specific pathologists

Study duration

3 months

Sample size

232 samples which were advised by consultants from OPD were observed for the study. Out of 232183 samples were taken for analysis. Rest 49 samples were excluded from study.

Methodology

This study utilized 232 outpatient specimens that were received from 8:00 a.m. until 5:00 p.m. at Yashoda hospital for routine one stop chemistry tests between 1 April 2013 and 30 May 2013. A total of 232 tests were performed; the 30 routine chemistry analysis were hematology, plasma total calcium, glucose, creatinine, uric acid, cholesterol, protein, albumin, AST, ALT, ALP, total bilirubin, direct bilirubin, phosphorous, urea,

gamma-glutamyl transferase, sodium, potassium, chloride, total CO₂, amylase, lactate dehydrogenase, triglyceride, HLD cholesterol, LDL-cholesterol, C-reactive protein, magnesium, lipase, CK, iron, and TIBC.

A program was developed to record and manage the time points entered into the Laboratory Information System (LIS), the time taken to fulfill each phase, the testing instruments, the operators, retesting, and verification, such as delta value, panic value, and critical value checking. During laboratory test processing, 4 time points were automatically recorded in LIS: i.e., “barcode printing” when the barcode was printed by an autolabeler and the specimen was accessed simultaneously; “scanning” when the barcode was scanned in the autoanalyzer; “result to LIS” when the result was transmitted from the instrument to the LIS after the analysis; and “result to HIS” when the verified result was transmitted from the LIS to the Hospital Information System (HIS). In this study, the TAT was classified into 3 phases on the basis of these 4 time points, i.e., preanalytical phase (barcode printing-scanning), analytical phase (scanning-result to LIS), and postanalytical phase (result to LIS-report to HIS).

The preanalytical phase consists of the following steps: barcode printing with simultaneous specimen accession; the wait for phlebotomy; phlebotomy; transport of the specimen from the blood-collection site to the laboratory via a conveyer belt; manual centrifugation; manual specimen loading on an autoanalyzer; and barcode scanning in the autoanalyzer. The analytical phase occurs in the autoanalyzer and consists of the following steps: barcode scanning; order retrieval from the LIS; analysis; and the result is sent to the LIS. The postanalytical phase consists of the following steps: the result is received by the LIS; verification (automatic or manual); and the report is sent to the HIS.

We utilized various tools in order to understand the current state of the process and suggest improvements for achieving the goal set by management. The approach taken in analyzing this workstation began with direct observation followed by process analysis and the use of historical data.

Figure 1: The approach taken in analyzing workstation began with direct observation followed by process analysis and the use of historical data.

Total lab TAT is broken down into three main stages. The portion of total TAT that lab management targeted as the main issue includes the time from when the specimen is collected by the phlebotomist until the specimen is queued for testing. The specific workstation analyzed constitutes only a portion of this stage. Due to the limited nature of the project, lab management specified the scope and workstation of interest.

Figure 2: Total lab TAT.

The observed clinical lab specializes in processing and testing a variety of specimen including blood, fecal matter, urine, and other fluid samples. Specimens arrive in the lab by two different drop-off windows and a bullet system (similar to a bank's drive-up window). The specific workstation we focused on was responsible for retrieving the specimen from the arrival locations and preparing them for testing. This workstation contains a Modular Pre-Analytics (MPA) machine which performs spinning and aliquot operations before the specimens are queued for testing. The complete process flow for this workstation is depicted in Figure 3.

After documenting the process flow, time studies were performed in order to determine the composition of process times and potential areas of improvement.

Standard times for the workstation were obtained by multiplying observed average times by a perceived pace rating with an addition of 15% allowance for fatigue.

From the historical data provided, the hourly trends in the number of specimens processed were analyzed over one week. Total specimens processed are highest at the beginning of the week and gradually decline until the end of the week. Peak hours are between 9 am to 2 pm.

A steep drop-off is seen during the weekend (Saturday and Sunday) as a result of limited patient appointments.

Figure 3: Workstation: clinical lab specializes in processing and testing a variety of specimen.

Data validation

Data validation is essential to ensure correct interpretation and meaningful comparisons. Validation is a continuous process which may incorporate various methods:

- Before data input, information validated by a second extractor
- If computerized data collection is used, the software should include input checks (each variable collected must be coded according to the protocol).
- Before analysis, a retrospective data validation performed to identify missing values, inconsistencies, outliers/possible errors, unexpected values or codes.

Data analysis

The mean TAT, Standard Deviation (SD), proportion of acceptable tests (% of TAT within 60 min), 90th percentile, 95th percentile, and 99th percentile of TAT were evaluated for the 232 specimen. The specimens were divided into 5 groups; TAT within 60 min, TAT between 60 and 90 min, TAT between 90 min and 120 min, between 120 min and 180 minutes and over 180 min. The average time taken to fulfill each phase was measured, and the contribution of each phase to the overall TAT was calculated.

When specimen results were reported after 60 min, each phase was investigated to determine the underlying reason for the lack of timeliness. Statistical software SPSS (Version 13.5, SPSS Inc., Chicago, IL, USA) was used for data analysis.

RESULTS

Total 232 diagnostic samples were observed. Out of 232183 samples (78.88%) were taken for analysis. Rest 49 samples (21.12 %) were excluded.

Table 1: Observation of diagnostic samples.

Samples	No. of samples	% of samples
Samples included	183	78.88
Samples excluded	49	21.12
Total	232	100

Figure 1: Observation of diagnostic samples.**Reasons for exclusion**

Out of 49 samples which were excluded, 15 (30.61%) samples were abnormal reports and 34 (69.39%) samples of master health check-up.

Table 2: Reasons for exclusion.

Reasons for exclusion	No. of samples	% of samples
Abnormal reports	15	30.61
Master health check-up	34	69.39
Total	49	100

Figure 2: Reasons for exclusion.**TAT for laboratory samples**

Out of total 183 samples included for study, 100 (54.65%) samples were within TAT time and 83 (45.35%) samples were delayed.

Table 3: TAT for laboratory samples.

TAT	No. of samples	% of samples
Within TAT	100	54.65
Delayed TAT	83	45.35
Total	183	100

Figure 3: TAT for laboratory samples.**Distribution of delayed TAT timings**

Out of total 83 samples which were delayed, 48 (57.83%) samples had TAT between 60 minutes to 90 minutes, 22 (26.51%) samples had TAT between 90 minutes to 120 minutes, 9 (10.84%) samples had TAT between 120 minutes to 180 minutes, and 4 (4.82%) samples had TAT over 180 minutes.

Table 4: Delayed TAT timings.

TAT time (minutes)	No. of samples	% of samples
60 -90	48	57.83
90-120	22	26.51
120-180	9	10.84
>180	4	4.82
Total	83	100

Figure 4: Delayed TAT timings. **Figure 5: Delayed TAT timings.**

Average time between sample collection and lab reach

Average time between sample collection and lab reach was observed to be 15 min. 38 sec. Ideal permissible time for sample to reach laboratory from collection time is 10 minutes. So there is a transport delay.

Instrumentation failure

- a. Biochemistry - 2 times
- b. Thyroid - 1 time

DISCUSSION

One of the most visible and talked about areas of laboratory service is how fast a test result is returned to a caregiver.⁵ Although stat tests are one of the most important features of clinical laboratory performance, the indexed literature is devoid of significant discussion on this subject.⁶

In our study we have used receipt of patient sample to verification time to monitor our TAT of stat tests. Laboratory managers often equate TAT with this time interval as this is most directly under the control of laboratory managers, but it should be kept in mind that this reports only the analytical and post-analytical process of testing.⁷

Our study reveals an outlier rate of 45.35% while other studies have reported it to be 10.4%.⁵ Most of the centers have used up to four analytes only in calculating delays in reporting time,¹⁰ however in our study we have included the whole battery of stat tests provided by our section which approaches to 33 analytes. It was found that most of the delay in TAT of stat test was more than 60 minutes. Most common reason for this delay was found to be transport delay followed by machine breakdown followed by problems in machine maintenance and overlook of technical staff. This was in contrast to the reasons for the delay in analytical phase reported in other studies.⁵ These have been attributed to shortage of highly trained personnel as the largest single cause in delay.

Other reasons for delay in receipt to verification time reported in other studies are due to technical delays i.e. difficulty with instrument, specimen delay i.e. abnormal results requiring verification, laboratory accidents and clerical delay which involves data entry etc.⁵

Another unexpected and interesting finding in our study was that most of the delay in TAT of stat tests occurred in the morning shift, while maximum staff strength is available at the disposal of the section. Increase in workload at this time could well be a reason for delay in TAT at this time of the day. A college of American pathologist Q-probes study has reported that preanalytic TAT increases during the day, which however indicates delays in transport and collection stages.⁸ Among other factors, which have been found to affect TAT of any

laboratory, it is the size. It has been reported that results were available sooner in non-teaching than teaching and in smaller rather than larger institutions.⁹

The figures in delay of TAT available in the literature from the western world are quiet high as in our figures. The management of the section, regular quality assurance, meeting with the technical staff and strict vigilance are required in our setting. The delay percentage prompted us to get a new automated analyzer and hopefully the delay percentage will be significantly reduced in the near future. A follow up study of similar nature with statistical analysis is required to prove the above hypothesis. We conclude that most of the delay in TAT of stat tests in our laboratory occurred for more than 60 minutes and was frequently seen in the morning shift. It was also noticed that machine breakdown was the most common reason for this delay. Regular audit of such data helps in the evaluation of the efficiency of the laboratory and hence corrective measures taken accordingly would be helpful in providing better service to the physicians and patients.

CONCLUSION

Following were the reasons for the delay in TAT in laboratory:

1. Transport Personnel carrying collected samples to lab is stucked at waiting for lift.
2. Shortage of Transport Personnel during peak hours.
3. Transport personnel walking through ramps/stairs.
4. Time consumption at sample collection counter, for cross check of samples, Barcode snickering, segregation as per departments and handing over those samples to the respective departments.
5. Frequent instrumentation failure.
6. Shortage of Typist in morning hours.
7. Abnormal reports are to be verified by Pathologist causing delay.
8. Shortage of sample carrying boxes (Blood samples & urine samples are carried in the same box).

Suggestions

1. Segregation of samples can be done at collecting centers, by which we can utilize the waiting time for the sample box to be filled.
2. OP sample collection room transport personnel with sample carrying boxes should be restriction free to use the lift while going to lab and also when returning back to collection center.

3. Additional transport personnel can be given during peak hours at Lab.
4. Sample carrying boxes should be separate for blood, urine and stool samples.
5. OP samples receiving should be given priority over ward samples.
6. Additional person for report typing during morning hours.
7. Pneumatic shoot can drastically reduce the sample carrying time.

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Ethical approval: The study was approved by the institutional ethics committee

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