Patel D et al. GAIMS J Med Sci 2025;5(2) (Jul-Dec): 51-57
Online ISSN: 2583-1763

Original Research Article

Turn Around Time (TAT): The Critical Link Between Laboratory Testing and Patient Outcome

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ABSTRACT

Background: Turnaround time (TAT) in a clinical biochemistry laboratory refers to the total time taken from when a test is ordered to when the result is reported back to the clinician. The study aims to evaluate the TAT time of the clinical biochemistry lab, assessing the pre-analytical and post-analytical phases' relative contributions to the TAT in comparison to the analytical phase and determining the quantity of samples reported outside the specified TAT. A number of actions that could shorten the turnaround time overall were also assessed.

Material and methods: The study was conducted at GKGH Hospital, Kachchh, a district hospital, to evaluate the turnaround time (TAT) on samples analyzed in the clinical Biochemistry laboratory. In the present study, TAT was evaluated for parameters such as RFT (Renal Function Test), SGPT (Serum glutamate Pyruvate transaminase), Electrolytes, Troponin, and ABG (Arterial Blood Gas analyzer). The samples were collected from the OPD and IPD. The clinical Biochemistry is equipped with Vitros DTS 5600 and 7600, a dry test-based auto-analyzer.

Results: In the present study, the mean and SD were observed in case of RFT TAT was 78 ±41, SGPT TAT was 103±54, Troponin TAT was 78±33, ABG test TAT was 15±12, Electrolytes TAT was 76 ± 42.

Conclusion: In the present study, Evaluation of TAT of basic emergency parameters, which are common tests done in the laboratory. We noticed the major cause of delayed TAT time is pre-analytic steps. By improving the phlebotomy procedure, sample transport flow, and sample preparation steps, the TAT time can be improved significantly.

Keywords: TAT, RFT, SGPT, Electrolytes, Troponin, ABG

INTRODUCTION

The ability of a good or service to meet the demands and expectations of the consumer is known as quality[1]. Turnaround time (TAT) in a clinical biochemistry lab refers to the total time taken from when a test is ordered to when the result is reported back to the clinician. The effects of TAT have been extensively studied, revealing correlations between emergency department treatment and length of stay[2]. It's a key performance indicator that affects clinical decision-making and patient care[3]. One of the most important metrics for evaluating laboratory performance is turnaround time. Efforts to enhance the overall service

quality, such as reducing laboratory turnaround time (TAT), demonstrate a greater awareness of patient needs[3]. The researchers have given several descriptions of TAT. Ordering of testing, collecting, identifying, transporting, preparing, analyzing, reporting, interpreting, and acting are the nine processes that make up the "total testing cycle"[4]. TAT is considered differently by clinicians and laboratory personnel. Laboratory personnel often utilize specimen receipt to report results as TAT, while clinicians take TAT into account from the time the test is ordered until results are reported[5]. Depending on the various stages of sample processing, TAT has also been divided into pre-analytical, analytical, and post-analytical categories. These divisions have often been used when classifying errors and delays and are sometimes used for the description of TAT[6,7]. Timely reporting of laboratory test results is currently regarded as a crucial component of the clinical laboratory's services, in addition to precision and accuracy. Patients and their doctors want reports as quickly as possible, regardless of whether a quicker turnaround time can have any medical impact. Timely reporting of lab test results plays a crucial role in improving outcomes in critical settings such as operating theaters and emergency departments. By prioritizing efficient communication of test results, we can enhance patient care and make informed decisions more quickly[8,9]. Timely TAT sparks urgent complaints from users, whereas satisfactory TAT often goes unnoticed[10]. Although laboratories have the opportunity and obligation to engage in all phases of the process, many opt to define turnaround time (TAT) exclusively based on intra-laboratory activities. They argue that factors outside their immediate control are responsible for delays and that precise timing data for external activities are often unavailable. This limited perspective significantly underestimates TAT since non-analytical delays can contribute up to 96% of the total turnaround time. Recognizing the full scope of TAT is crucial for enhancing efficiency and improving overall performance[11,12]. The present study is aimed to evaluate the TAT time of the biochemistry laboratory, assessing the pre-analytical and post-analytical phases relative contributions to the TAT in comparison to the analytical phase and determining the number of samples reported outside the specified TAT. A number of actions that could shorten the turnaround time overall were also assessed.

MATERIALS AND METHODS

The present study was conducted at GKGH Hospital, Kachchh, a tertiary care hospital, to evaluate the turnaround time (TAT) on samples received in the clinical Biochemistry laboratory. TAT is the time interval between the sample obtained and result verification. In the present study, TAT was evaluated for parameters such as RFT (Renal Function Test), LFT (Liver Function Test), Electrolytes, Troponin, and ABG (Arterial Blood Gas analyzer). The samples were received from OPD and IPD. The clinical Biochemistry is equipped with Vitros DTS 5600 and 7600, a dry test-based auto-analyzer. The biochemistry test parameters, except ABG, were estimated in Vitros DTS 5600 and 7600. The samples of ABG were estimated on an ABL-Radiometer. Samples from outdoor patients were collected in the designated sample collection area by trained phlebotomists. In contrast, samples from indoor patients were drawn by the nursing staff in their respective wards. The samples from both outdoor and indoor patients were then transported to the laboratory by their attendants. Upon arrival at the laboratory, the samples were first screened for any pre-analytical errors before being processed. The quality control program is implemented in which Quality control samples were run daily in the laboratory for all analytes to identify any intra-assay variation. The quality samples are analyzed twice a day with an analytical range of normal control and abnormal control. The samples received in the laboratory were processed in the order they arrived, except for those from emergencies, which were run on STAT mode as soon as they came in, including ABG samples. Samples rejected for the reason of being hemolyzed, lipemic, and icterus were excluded from the study.

The hospital and laboratory instruments were interfaced with hospital software, HIMS. The Vitros DTS 5600 is a sophisticated instrument that monitors each sample and reflects on the screen. The machine is well calibrated, and daily, weekly, and monthly maintenance activity is performed regularly. This scheduled activity was performed to prevent any delay

for the reason of the machine. The samples were barcoded and analyzed for respective tests.

The post-analytical steps included verification and approval of results performed by the section in charge. The dispatched results are viewed either on software or taken as printed reports.

Inclusion criteria:

The samples were performed routinely in the clinical Biochemistry laboratory from OPD and IPD.

Exclusion criteria:

1.The outsourced tests

2.The samples that were rejected because of hemolysis, turbid, and icteric reasons.

The turnaround time (TAT) has been monitored in 500 samples taken from patients in OPD and 270 and 230 samples from IPD patients. The preanalytical phase has the following phases: sample acquisition and barcode printing. Then, the samples were followed by centrifugation and serum separation. The pre-analytical steps were followed by analytical steps where samples were analysed in vitros DTS autoanalyzer. The post-analytical phase includes the results verification, approval, and dispatch through HIMS software.

Statistical analysis:

Statistical analyses were performed with SPSS and Microsoft Excel. The mean and SD of the data for each parameter were analyzed as the data were normally distributed, which was checked by the Kolmogorov-Smirnov test of normality. For time-related variables, a paired t-test was applied. The median and interquartile range for various times were also provided. The ideal cut-off value for defining TAT was determined to be the 75th percentile. As discrete categorical data, the number of tests required to provide values greater than the 75th percentile was expressed as n%. SPSS version 17 was used to conduct all two-sided computations. P-values less than 0.05 were regarded as statistically significant.

RESULTS

The analysis of 500 samples was carried out in the clinical biochemistry laboratory. Out of a total 450 samples, 270 were from OPD, and 230 were from IPD. In the present study, we investigated TAT time for RFT (Renal function test), SGPT (serum glutamate Pyruvate transaminase), ABG (Arterial Blood gas analysis), and Serum electrolytes.

Table-1: TAT time in the Pre-analytical, Analytical, and Post-Analytical phases

	Pre-Analytical	Analytical phase	Post Analytical Phase	TOTAL TAT
OPD	47± 8.3	62 ± 13.2	24 ± 18.5	158 ± 28
IPD	52±14.2	68± 11.8	28 ± 16	161 ± 41

Table-1 shows the time taken to complete the pre-analytical, analytical, and post-analytical phases in both OPD and IPD samples. The average turnaround time in OPD and IPD was 158± 28 and 161 ± 41 minutes, respectively. In the OPD sample collection process, the phlebotomy procedure took 14 ± 4.3 minutes, while the sample transportation duration was 21 ± 8.7 minutes. In the case of IPD, the average times for sample collection and transportation were 21 ± 7.2 minutes and 28 ± 9 minutes, respectively. The sample preparation time, which encompasses centrifugation and the entry of sample data into the lab register, averaged 11 ± 4 minutes. Notably, samples designated for emergency testing were marked to prioritize their analysis. The analytical process involved sample analysis, monitoring, and results verification. The analytical phase took about 62 ± 13.2 minutes for outpatients (OPD) and 68 ± 11.8 minutes for inpatients (IPD). Report dispatch for both groups was managed through the hospital software system (HIMS), with manual printouts in respective wards.

The post-analytical phase took approximately 24 ± 18 minutes in OPD and 28 ± 16 minutes in IPD. The analytical process involved sample analysis, monitoring, and results verification. The time taken for completing the analytical phase in both OPD and IPD was significantly less (p= 0.027 in OPD, p= 0.047 in IPD) than the combined pre- and post-analytical time in both OPD (71 ± 24.1 minutes) and in IPD (70 ± 28 minutes). Also, the contribution of analytical time to the total TAT in OPD (39.2%) and in IPD (42.2%).

Table-2: TAT time and distribution of the study parameters

	SGPT (Time in Min)	RFT (Time In Min)	Troponin (Time In Min)	ABG (Time in Min)	Electrolytes (Time In Min)
Mean	103	78	78	15	76
SD	54	41	33	12	42

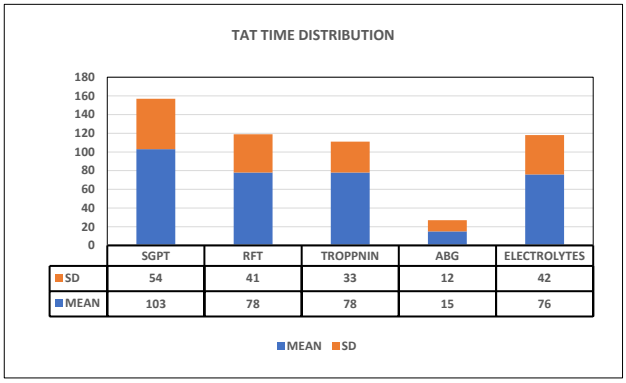

Figure-1: TAT time and distribution of the study parameters

Table-2 shows the Mean and the SD of the TAT time test parameters. The mean and SD of SGPT was 103± 54 minutes, and the mean and SD of RFT test, which includes serum urea and serum creatinine, was observed at 78 ± 41 minutes. The mean and SD for troponin was 78±33 minutes. The ABG test mean and SD were found to be 15±12 minutes. The electrolytes mean and SD were observed at 76 ± 42 minutes. In the present study, the TAT time of test parameters distribution was observed in the following manners.

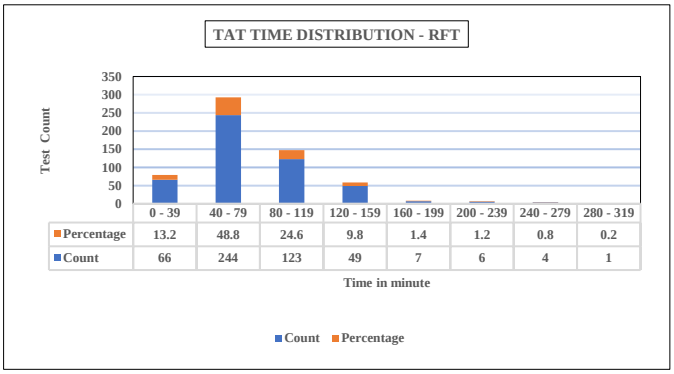

Figure-2: TAT time distribution of RFT

Figure-2 shows the evaluation of TAT for test parameters RFT, which includes serum urea and serum creatinine. The TAT time for RFT is 180 minutes. The mean and SD of RFT TAT time is 78 ±41. In the present study, 96.4% of RFT test done within TAT time.

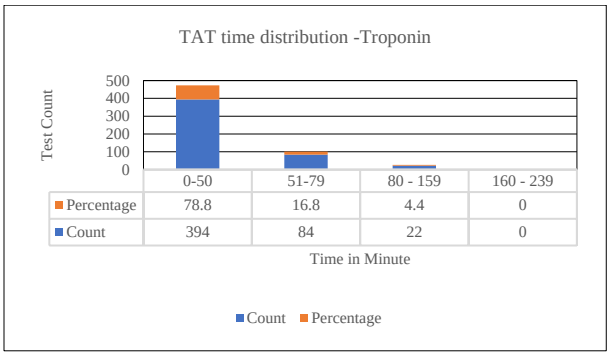

Figure-3: TAT time distribution of TROPONIN

The TAT time mean and SD of the troponin test was 78±33. From figure-3, it is observed that out of 500 samples, 394 samples (78.8%) were reported within 50 minutes. The TAT time for troponin is set to 40 minutes. 16% of the total samples were reported within 70 minutes, while the remaining 4% of the test were reported with a time above 80 minutes.

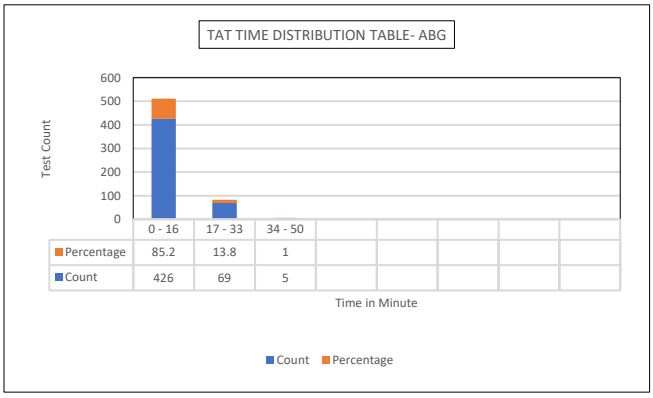

Figure-4: TAT time distribution of ABG

The TAT time mean and SD of the ABG test was 15±12. TAT time of ABG is 15 minutes; in the present study, it was observed that a total of 426 samples (85.2%) out of 500 were reported within 16 minutes. The rest of the total 14 % samples were reported within 30 minutes. 13% of the samples had TAT time above the defined time.

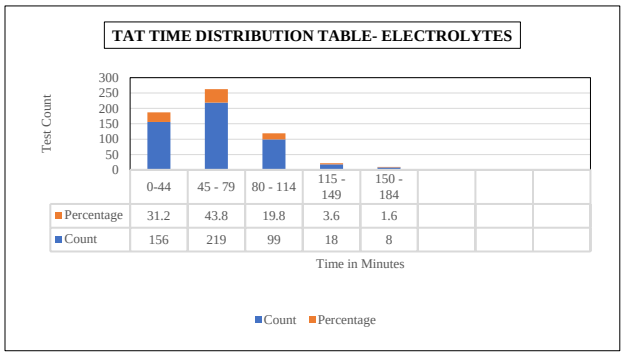

Figure-5: TAT time distribution of ELECTROLYTES

The TAT time mean and SD for Electrolytes was observed at 76±42. From the Figure-5, it was observed that 156 samples (31.2%) were reported within 40 minutes, 219 (43.8%) samples were reported within 40-80 minutes of time. 20% of the samples were reported within 120 minutes of time. 4% of the total samples were reported above 160 minutes. 3% of the samples were above TAT time.

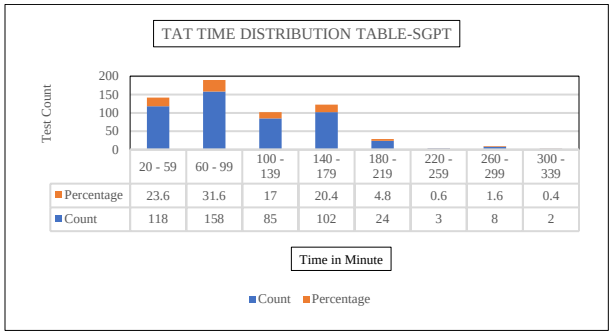

Figure-6: TAT time distribution of SGPT

The mean and SD of SGPT TAT time was observed 103 ±54 minutes. The TAT time for SGPT defined is 180 minutes. From the Figure-6, it was observed that out of 500 total samples, 118 samples (23%) were reported within 60 minutes. 160 samples (31%) were reported within 90 minutes. 85 samples were reported within 140 minutes. 7.4 % samples were outliers of the TAT time.

DISCUSSION

Turnaround time (TAT) is a key performance indicator in clinical laboratories that reflects the time taken from sample receipt to result reporting. Efficient TAT is crucial for timely clinical decision-making, especially in critical care and emergency settings. How quickly a test result is sent back to a caregiver is one of the most noticeable and discussed aspects of laboratory services. However, several procedures affect TAT and cause numerous delays that are not within the control of laboratory specialists[8]. The pre- and post-analytical phases are equally significant as the analytical phase[13]. The institution and the patient are both impacted by how quickly test findings are reported[14]. Delaying the test results results in the reissue of the same test, which ultimately affects the cost and time of the healthcare system[15]. Therefore, the evaluation of TAT time is of prime importance to any medical laboratory.

In the present study, we evaluated the basic emergency test parameters such as ABG, electrolytes, and Troponin. We also investigated common test that includes SGPT and RFT ordered from OPD and IPD. In the present study, we observed for ABG samples that 85.2% of samples were within a defined TAT, and 13 % of samples were fall outliers. The other emergency test evaluated was troponin. In that, we observed 84 % samples were within the defined TAT where whereas 16 % samples were outliers. The TAT evaluation for electrolytes shows 96% within TAT and 4% were outliers. The TAT for SGPT and RFT is set to 160 minutes; we observed that SGPT test 92.6% were within TAT and 7.4 % were outliers. RFT test shows 4.6 % outliers and 96.4% within TAT.

By performing root cause analysis, we observed there was greater influence on TAT from pre-analytical and post-analytical factors daily. The major reason for the delay in the pre-analytical phase was sample transport. The other reason observed was shift change. With the use of a pneumatic system, the time required to get the specimen from the phlebotomy location to the laboratory can be decreased. According to McQueen, the addition of a pneumatic tubing system resulted in a notable decrease in TAT[16,17]. Numerous studies have demonstrated the effectiveness of the pneumatic system, a ground-breaking invention that has transformed sample transportation in minimizing unintentional delays caused by human couriers[18]. A study by Groenewald et al. observed significant improvement in pre-analytical TAT time after the implementation of a pneumatic suit for sample transport. Their study also found improvement in

troponin tests after installing a fully automated analyzer[19,20]. In the present study, there was a positive influence of auto-analyzer seen in improvement of TAT time as the lab is equipped with fully auto analyzer which have high through-put, auto dilution mode when result is above linearity. In the analytical phase, quality control procedures and strict supervision also improved TAT. In post post-analytical phase, the lab is interfaced with hospital software, so prompt verification and results approval also contributed to TAT. In case of machine breakdown, the lab is equipped with alternative back up of fully auto, so there was no delay seen in result analysis because of such issues.

CONCLUSIONS

In the present study, we evaluate TAT time of basic emergency parameters and two routine parameters, which are common tests done in the clinical laboratory. We noticed the major cause of delayed TAT time is pre-analytic steps. By improving the phlebotomy procedure, sample transport flow, and sample preparation steps, the TAT time can be improved significantly.

Limitation of The Study:

As this is a cross-sectional study, in the laboratory, the workload changes seasonally and monthly. Workflow delays are more likely to happen with larger sample sizes and more intensive studies. TAT records based on the admission month may help to evaluate TAT in a better way.

REFERENCES

1. Bergman B, Klefsjö B. *Quality: From customer needs to customer satisfaction*. London: McGraw-Hill; 1994.

2. Hawkins RC. Laboratory turnaround time. *Clin Biochem Rev*. 2007; 28:179-94.

3. Hilborne LH, Oye RK, McArdle JE, Repinski JA, Rodgerson DO. Evaluation of stat and routine turnaround times as a component of laboratory quality. *Am J Clin Pathol*. 1989; 91:331-5.

4. Kenagy JW, Berwick DM, Shone MF. Service quality in health care. *JAMA*. 1999; 281:661-5.

5. Lundberg GD. Acting on significant laboratory results. *JAMA*. 1981; 245:1762-3. doi:10.1001/jama.245.21.2212

6. Weinstein S. Quality in pathology laboratory practice. *J Qual Clin Pract*. 1995; 15:121-6.

7. Truchand A, Le Neel T, Brochard H, Malvaux S, Moyon M, Cazaubiel M. New tools for laboratory design and management. *Clin Chem*. 1997; 43:1709-15.

8. Valenstein P. Turnaround time. Can we satisfy clinicians' demands for faster service? Should we try? *Am J Clin Pathol*. 1989; 92:705-6.

9. Steindel SJ. Timeliness of clinical laboratory tests: a discussion based on five College of American Pathologists Q-Probe studies. *Arch Pathol Lab Med*. 1995; 119:952-61.

10. Saxena S, Wong ET. Does the emergency department need a dedicated stat laboratory? Continuous quality improvement as a management tool for the clinical laboratory. *Am J Clin Pathol*. 1993; 100:606-10.

11. Howanitz PJ, Steindel SJ. Intralaboratory performance and laboratorians' expectations for stat turnaround times. A College of American Pathologists Q-Probes study of four cerebrospinal fluid determinations. *Arch Pathol Lab Med*. 1991; 115:977-83.

12. Manor PG. Turnaround times in the laboratory: a review of the literature. *Clin Lab Sci*. 1999; 12:85-9.

13. Rollo JL, Fauser BA. Computers in total quality management. Statistical process control to expedite stats. *Arch Pathol Lab Med*. 1993; 117:900-5.

14. Steindel SJ, Novis DA. Using outlier events to monitor test turnaround time. A College of American Pathologists Q-Probes study in 496 laboratories. *Arch Pathol Lab Med*. 1999; 123:607-14.

15. Lu Y, Leong W, Wei B, Yu P, Wang C, Ying Y, et al. An evaluation of laboratory efficiency in Shanghai emergency by turnaround times level. *J Clin Lab Anal*. 2015; 29:334–41.

16. Valenstein P. Laboratory turnaround time. *Am J Clin Pathol*. 1996; 1:676–88.

17. Barnett RN, Bimmell M, Peracca M, Rosemann K. Time interval between ordering and obtaining laboratory test results. *Pathologist*. 1975; 29:3–8.

18. McQueen MJ. Role of the laboratory in meeting the needs of critical care. *Clin Biochem*. 1992;26(1):8–10. doi:10.1016/0009-9120(93)90005-Q

19. Fleisher M, Schwartz MK. Automated approaches to rapid-response testing. A comparative evaluation of point-of-care and centralized laboratory testing. *Am J Clin Pathol*. 1995;104: S18–S25.

20. Groenewald AJ, Potgieter HD. Physician satisfaction and emergency (stat) laboratory turnaround time during various developmental stages. *Med Technol*. 2014; 28:20–5.

Source of support: Nil

Conflict of interest: None

How to cite: Patel D, Sharma D. Turn Around Time (TAT): The Critical link between Laboratory Testing and Patient Outcome. GAIMS J Med Sci 2025;5(2): 51-57. https://doi.org/10.5281/zenodo.15688715