IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 17, Issue 9 Ver. 3 (September. 2018), PP 06-09
www.iosrjournals.org

Total Turnaround Time ofClinical Laboratory – An Assessment tool for Laboratory Performance

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Abstract: *Introduction: Diagnostic turn around time is defined as the interval between the time of sample collection and the report dispatched to the patient. Objective of this study was to calculate the turn around time (TAT) for routine investigations done for OPD and IPD patients. We also aimed to find the time required for pre-analytical, analytical and post-analytical phases and their contribution to total TAT in terms of percentage.*
Methodology: Total of 51,702 samples were analyzed in the Clinical Laboratory, Adarsha Hospital, Udupi. Inpatient specimens accounted for 66% (34,165) and outpatient specimens accounted for 34% (17,537) of the total specimens. Time was noted at the time of phlebotomy, identification, transportation, separation, analysis, reporting and interpretation of the report. The whole process is divided in to pre-analytical, analytical and post-analytical phases. A log book was maintained for this purpose from which total TAT as well as percentage contribution of each phase to total TAT was calculated.
Results: The average TAT for the OPD and IPD routine parameters is 65 min& 85 min respectively. Major contribution to TAT is from pre-analytical phase ,around 62% , analytical 25-30% and by post-analytical phase by 7-12%.
Conclusion: TAT is an important parameter for the laboratory as well as for the hospital in assessing the laboratory services. It is an important quality indicator as well.TAT for both OPD and IP samples were excellent in our laboratory.
Key words: turnaround time,Quality indicator, pre-analytical, analytical, post-analytical phases
Running title: TAT and clinical lab

Date of Submission: 28-08-2018 Date of acceptance: 10-09-2018

I. Introduction

Turn around time (TAT) is the timeliness with which laboratory personnel deliver test results. It is one of the most noticeable signs of laboratory service and is often used as a key performance indicator of laboratory performance. In our laboratory, TAT is defined as the interval between ‘‘the time of sample collection’’ and ‘‘the report is dispatched to the patient’’. This is called diagnostic turnaround time. However, for a clinician, it would be the time of his/her requisition of a test till the report reaches him/her. Clinicians depend on fast TATs to achieve early diagnosis and treatment of their patients and to achieve early patient discharge from emergency departments or hospital in-patient services. Delayed TATs also increases the frequency of duplicate samples sent to the laboratory. This further increases the workload on the laboratory. Assessment and improvement of turnaround times is essential for laboratory quality management as well as ensuring patient satisfaction
TAT is further subdivided into three phases pre-analytical, analytical & post-analytical. Marking the timings on six occasions so that we can get information on the subdivided TAT, which further helps us to understand the delay was due to which phase or process and this can be addressed in depth to reduce the TAT. Laboratory personnel give more importance to the quality , accuracy and precision and least importance is given to turnaround time (TAT). However, service to patient by a hospital would be assessed by the rapidity of result delivery as seen by TAT. Therefore TAT is a very important tool by which a laboratory is assessed. Lundberg described TAT as ‘Brain to Brain TAT’ or ‘‘total testing cycle’’ and divided the whole process into nine smaller ones, each independent ones, bearing impact on TAT[1]. These steps are ordering, collection, identification, transportation, separation, analysis, reporting, interpretation, and action [1].

Objectives of the study were to
i. calculate the turnaround time for the various biochemical and hematology tests, carried out both on OPD and IPD basis. ii. find the percentage contribution of pre-analytical, analytical and postanalytical phases to TAT.

II. Materials and Methods

The study was conducted in the Clinical Laboratory , Adarsha Hospital, a two hundred bedded super speciality hospital located at Udupi. The clinical laboratory in the hospital is equipped with fully automated Clinical chemistry Analyzer, EM-200, hormone analyser which works on the principle of immunofluorescence,Minividas, electrolyte analyser, Arterial blood gas analyser ,semi-automated chemistry analyser,coagulation analyser and a urine analyser. The study was conducted between November 2017 to July 2018. During the present study period, a total of 51,702 specimens were analysed in the Clinical Laboratory. Inpatient specimens accounted for 66% (34,165) and outpatient specimens accounted for 34% (17,537) of the total specimens. Blood specimens were collected in the sample collection area which is adjacent to Clinical Biochemistry Lab by trained technicians for all OPD patients. In patient phlebotomies were also performed by trained technicians of the laboratory.After screening the samples for any pre-analytical errors, the analytical process was commenced. Processing and analysis of the samples was carried out by our technicians and is supervised by the Lab Incharge. Routine maintenance, calibration and quality control evaluation was carried out. The sample run was initiated only after satisfactory quality control results. A total of 1,99,917 tests were performed ;routine chemistry analytes analyzed were plasma total calcium, glucose, creatinine, uric acid, cholesterol, protein, albumin, AST, ALT, ALP, total bilirubin, direct bilirubin, urea, gamma-glutamyl transferase, sodium, potassium, chloride, HDL-cholesterol, LDLcholesterol and triglycerides,magnesium,CK NAC,CK-MB, hormones, tumor markers, urine analysis,analysis of body fluids,rapid diagnostic tests for various infectious diseases, hemogram etc were performed . The ward reports were dispatched after appropriate validation by the lab incharge. OPD reports are collected by patients/bystanders. Time was noted during sample collection, transport, processing, analysis and report dispatch by the technicians in a log book. In this study, we have classified TAT into 3 phases. Preanalytical phase, analytical phase, and postanalytical phase. The preanalytical phase consists of the following steps: Waiting time for phlebotomy, Phlebotomy, Identification, Transportation and sample preparation, centrifugation. Analytical phase consists of analysis step. Postanalytical phase consists of generation of reports and dispatch. The average time taken to complete each phase was measured, and the contribution of each phase to the overall TAT was calculated. TAT was calculated andstatistical analysis was done by descriptive statistics.

III. Results

Total Turnaroundtime of inpatient and outpatient departments are calculated and represented in Table 1. Percentageofcontributionofpre-analytical, analyticalandpostanalyticalphasestotal Turnaroundtimeare expressed in Table 2.

Table 1: Calculation of Turnaround time for routine Clinical chemistry parameters

Time in minutes	Inpatient department routine tests	Outpatient department routine tests
Waiting time for phlebotomy	10’	5’
Phlebotomy	10’	10’
Identification	5’	5’
Transportation	10’	5’
Preparation	15’	15’
Analysis	20’	20’
Reporting	10’	5’
Total TAT	80’	65

Table 2: Percentage of contribution of pre-analytical, analytical and postanalytical phases to Total Turnaround time

Different phases of analysis	Inpatient department tests (%)	Outpatient department tests (%)
Pre-analytical phase	62.5	61.5
Analytical Phase	25	30.8
Post-analytical phase	12.5	7.7

IV. Discussion

Our study demonstrates that the average TAT for the OPD and IPD routine parameters65 min and 80 minutes respectively(Table 1). The pre-analytical phase contributes 62.5% to TAT for IPD routine tests. This phase is mainly delayed by transportation of samples. Analytical phase contributes 25% and 12.5% is the contribution of post-analytical phase to TAT(Table 2). Post-analytical causes also have an important role in delaying TAT. Studies by Manor et al [2] and Rollo et al. [3] reported that the non analytical delays, such as transporting and reporting delays, are the key causes of delay in laboratory TAT and Bilwani et al. [4] had found

the delay was due to pre analytic cause in 74. 2 % of samples. Study by Kiran Pet al reported that 45 % of specimens having exceeded TAT was due to various non-analytical delays and almost 35 % were due to all phases delay[5].

It is evident from the results that turnaround time in our clinical laboratory is excellent. However , there was a delayed turn around time for around 20-25 samples per month on an average.The reasons for this delay werehemolyzed samples requiring resampling, insufficient sample, rechecking of test results, duplication of the assay, clinicians' request for resampling, rejection of inappropriate samples etc. When the causes for delayed turn around time were analysed, it was observed that 99% of them were due to pre-analytical reasons.

So pre-analytical errors need to be corrected so as to improve TAT . TAT has been described in various ways by the researchers. The ''total testing cycle'' describes TAT as consortium of nine steps ordering, collection, identification, transport, preparation, analysis, reporting, interpretation, and action [1]. TAT can be classified as pre analytical, analytical and post-analytical depending on the different phases of sample processing [6]. Our results suggest that if the pre-analytical phase is streamlined, delayed TAT of a few samples could be avoided. There are different ways in which each of the phases—pre-analytical, analytical and post-analytical phases can be expedited in order to achieve optimum turnaround time. Many studies have proven the efficiency of this mechanism in reducing inadvertent delays as a result of human courier [7]. Study by McQueen et al found that inclusion of a pneumatic tubing system led to a significant reduction of TATs [8]. The other means of minimizing pre-analytical delays were adoption of ideal phlebotomy practices, bar coding of samples and computer generated requisition slips. All these practices reduce the delays that are incurred as a result of illegible slips and faulty sample collection techniques. Use of gel vacutainers can reduce the delays that are caused during centrifugation. Fernandes et al believed that specimen collection by nurses was the reason for prolongation of TAT in their study and suggested that assigning dedicated personnel for drawing blood would reduce this time[9]. Hence trained technicians were assigned the job of phlebotomy both for inpatients as well as out patients.

The analytical phase can be streamlined by complete automation of laboratories, use of machines with higher throughputs, use of plasma or whole blood samples, primary tube sampling, ensuring minimal downtime and adequacy of backup, adoption of efficient quality control procedures, automatic dilutions in case of results exceeding linearity, prompt validation of reports etc. It is also essential to ensure effective division of labour among the technicians so that sample processing and reporting occurs smoothly. The staff should be trained to handle urgent samples with utmost care and expedite their processing [10-12]. The post analytical phase is dramatically improved with the adoption of laboratory information services (LIS). This will abolish transcriptional errors and delays caused in report dispatch to the respective wards. The report delivery was speeded up by the deployment of additional personnel for this task as suggested by Georgiou et al [13]. The other strategies that wereadopted were prompt information to the wards regarding critical values and preanalytical errors so that repeat samples were processed without much delay. There is a pertinent need to devise transparent and effective communication system between the clinicians and laboratorians [14]. It is clear from our critical self-appraisal of our laboratory services that we have improved the analytical phase by automation, elaborate documentation and communication of critical values and recruitment of trained laboratory personnel. Training of phlebotomist & using of Vacutainer (instead of syringe and needle) will minimize time required for phlebotomy. Pre analytical processing (centrifugation and specimen distribution was made quicker by posting of more efficient personnel at peak hours. More centrifuging machines were put to use. Analytical Delay in analyte testing due to heavy workload, equipment breakdown was reduced by proper maintenance and servicing of instruments. Proper human resources utilization, procuring stand by equipment like chemistry analyzer& electrolytes analyzer etc has effectively improved TAT. Post analytical Delay in transcription of the result from the equipment to the register & from the register to the LIS can be overcome by Interfacing all the equipments with laboratory information system (LIS). Result validation (review and clinical correlation) can be achieved if the Physiciansprovide probable clinical diagnosis or indication of test with a brief clinical history.

Steps for Improving Turnaround Time is a continuous long term process. Accessioning of samples was done by bar code readers which was manual earlier. Timely quality control measures, both internal and external, and updated standard operating protocols in the laboratory may be the reason for excellent TAT . Computerization of laboratories using improved softwares to interface instruments, to review results and to deliver reports to clinicians may go a long way to improve productivity of fastest TAT [15, 16] .

V. Conclusion

In conclusion, TAT is an important parameter for the laboratory as well as for the hospital in assessing the laboratory service. It is an important quality indicator as well.TAT for both OPD and IP samples were excellent in our laboratory. It has been a challenging task to control non-analytical factors that affect TAT adversely.

Conflicts of interest : None

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Dr G.S Chandrashekhar." Total Turnaround Time ofClinical Laboratory – An Assessment tool for Laboratory Performance””."IOSR Journal of Dental and Medical Sciences (IOSR-JDMS), vol. 17, no. 9, 2018, pp 06-09.