International Journal of Medicine Research
www.medicinesjournal.com
ISSN: 2455-7404
Received: 05-09-2021, Accepted: 21-09-2021, Published: 06-10-2021
Volume 6, Issue 4, 2021, Page No. 1-5

Determination of turn around time (TAT): A key indicator of the laboratory performance

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Abstract
Background: Timely reporting of laboratory test results is a crucial indicator of the quality services along with accurate, precise and reliable reports. Therefore, we analyzed the laboratory performance based on the monthly TAT achieved using a performance indicator developed by the in-house laboratory information system (LIS) software at our laboratory.
Methods: A total of 14652 accessions and 24363 tests performed over a period of six months were included. We defined TAT as the time from sample accessioning in lab to report release. The pre-defined TATs for various tests were fed to the LIS and an in-house software performance indicator was developed for regular monitoring of TAT. The tests were divided into short lead (TAT <90 mins) and long lead tests (TAT - 90-180 mins). Lab category wise monthly distribution of TAT achieved for accessions were analyzed. Various factors affecting TAT were also evaluated and improvement measures were suggested.
Results: The highest number of accessions and tests were 3119 (21%) and 6047 (25%) respectively in March. Majority of the accessions were from biochemistry constituting 34% followed by hematology (26%) and serology (14%).Out of 24363 tests, 21439 (88%) were short lead tests and 2924 (12%) were long lead tests. 100% TAT was achieved in serology, coagulation and nephelometry categories. The overall TAT outlier rate accounted for 2.6%.
Conclusions: Efficient lab performance depends on achieving rapid TAT. Regular monitoring of TAT data helps in evaluating the reasons for delayed TAT. Regular lab review meetings, strict vigilance of quality assurance, maintenance of inventory and consumption details, regular feedbacks from clinicians and patients, speedy procurement of clinical history significantly helps in improving the lab TAT.

Keywords: turnaround time (TAT), quality service, performance indicator, repeat assays, problem samples

Introduction

Glucose-6-phosphate dehydrogenase enzyme is an enzyme present in the cytoplasm of all body cells involving Turnaround time (TAT) is used to assay the performance of lab [1]. TAT can be defined differently according to the test type (stat vs routine), analyte and institutions [2]. In our laboratory, TAT was defined as the time taken from the specimen accession in lab to report dispatch/ release. Timely reporting of laboratory test results is a crucial indicator of the quality services along with accurate, precise and reliable reports [3]. Shortened TAT is important for early diagnosis and treatment that in turn decreases the patient's hospital stay and consequently increases their satisfaction and safety [4, 5]. Laboratory TAT is essential both from medical and commercial point of view. Therefore, every lab should determine the TAT regularly to ensure quality and timeliness of test results dispatch.

Aims and Objectives

1. To study the monthly distribution of total accessions under each laboratory category.
2. To list out the various tests performed under each laboratory category and their respective pre-defined TATs.
3. To analyze the laboratory performance based on the monthly TAT achieved using a performance indicator [developed by the in-house laboratory information system (LIS) software].
4. To evaluate the various reasons for delay in TAT and to suggest measures to improve the TAT.

Materials and Methods

The present study was of a retrospective, cross-sectional, descriptive design spanning over a period of six months (January 2021 to June 2021). A total of 14652 accessions and 24363 tests performed were included in the study. The test requests were received from out-patient departments (OPDs), in-patient departments (Wards, casualty, OTs) and master health check ups.

Inclusion criteria

1. All the tests as advised by the clinicians and which were performed in the lab.
2. Tests havinga pre-defined standard TAT in the LIS.

Exclusion criteria

1. Tests for which Test requisition form (TRF) was not received.
2. Microbiology, histopathology and cytology samples were excluded.
3. WIDAL test, Mantoux test, Glucose Challenge Test (GCT), Glucose Tolerance Test (GTT), hormonal assays and tests requiring 24 hours sample collection were excluded.

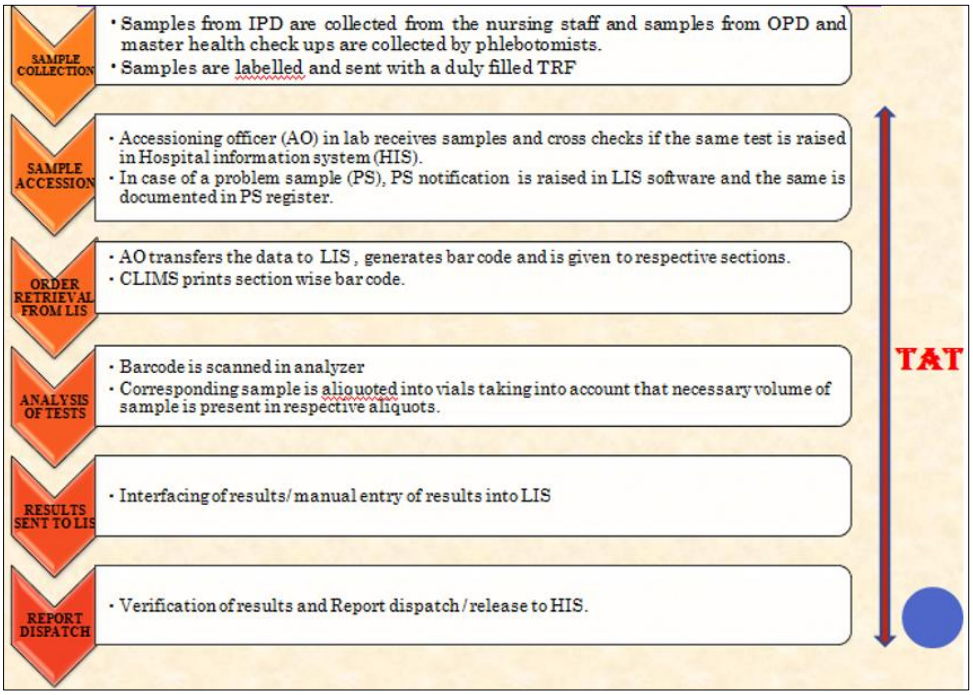

Fig 1: Workstation/total testing process of laboratory

In our study, TAT was defined as the time from sample accessioning in lab to report release (Fig 1). The pre-defined TATs for various tests were fed to the LI Sand an in-house software performance indicator was developed for regular monitoring of TAT-Lab category wise, section wise and product/test wise (Fig 2,3).A total of 54 various tests were performed under different lab categories. The tests were divided into short lead (TAT <90 mins) and long lead tests (TAT between 90-180mins).

We analyzed the lab category wise monthly distribution of TAT achieved for the accessions. TAT greater than95% was considered as satisfactory. For the lab categories whose monthly TAT achieved was<95% and also when 100% TAT was not acheived, various factors affecting TAT were evaluated and improvement measures were suggested.

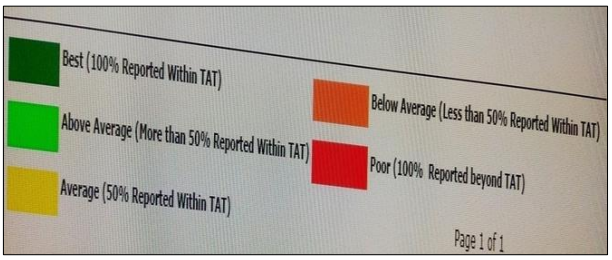

Fig 2: The performance indicator for monitoring monthly TAT.

Lab Category Wise TAT - KPI

Lab Category Name / Code	Performance Indicator	Acc Count	TAT			
			Not Achieved		Achieved	
			Count	%	Count	%
		2069	153		1916	
ENDOCRINOLOGY - (ENDO)		76	8	11%	68	89%
MICRO BIOLOGY - (MICBIO)		41	14	34%	27	66%
SEROLOGY - (SERO)		142	9	6%	133	94%
CLINICAL PATHOLOGY - (CLINPATH)		191	0	0%	191	100%
COAGULATION - (COAG)		154	3	2%	151	98%
IMMUNOHAEMATOLOGY - (IMMHEMAT)		81	27	33%	54	67%
BIO CHEMISTRY - (BIOCHEM)		879	65	7%	814	93%
HAEMOTOLOGY - (HEM)		505	27	5%	478	95%

Fig 3: Lab category-wise monthly TAT monitoring using the performance indicator

Results

A total of 14652 accessions and 24363 tests performed within a period of six months (January 2021 to June 2021) were included in the study. The highest number of accessions were reported in the month of March [3119 (21%)] and the highest number of tests were performed in the month of March [6047 (25%)] (Table 1). Highest number of accessions were from biochemistry constituting about 34 % of the total number of accessions, followed by hematology (26%) and serology (14%) (Table 2).

Table 1: Monthly distribution of the accessions versus total tests performed

Month	No. of accessions	No. of tests performed
Jan	2205 (15%)	4244 (17%)
Feb	2541 (17%)	3374 (14%)
Mar	3119 (21%)	6047 (25%)
Apr	2640 (18%)	4524 (19%)
May	1982 (14%)	3003 (12%)
Jun	2165 (15%)	3171 (13%)
Total	14652	24363

Table 2: Lab category wise monthly distribution of the accessions

Sl.no	Lab category	Total no. of accessions in each month						total
		Jan	Feb	Mar	Apr	May	jun	
1.	Hematology	632	727	899	671	500	447	3876 (26%)
2.	Biochemistry	862	930	1159	822	646	627	5046(34%)
3.	Serology	232	326	398	493	272	273	1994(14%)
4.	Coagulation	139	161	137	174	226	258	1095(8%)
5.	Immunohematol-ogy	77	100	104	52	52	20	405(3%)
6.	Clinical pathology	223	266	383	189	131	106	1298(9%)
7.	Nephelometry	40	31	39	239	155	434	938(6%)
Total		2205	2541	3119	2640	1982	2165	14652

Out of a total of 24363 tests performed, 21439 (88%) of the tests were short lead tests with TAT being within 90 mins and the rest 2924 (12%) were long lead tests with the TAT being within 90 to 180 mins (Fig 4).

A total of 54 analytes were tested under various lab categories (Table 3).

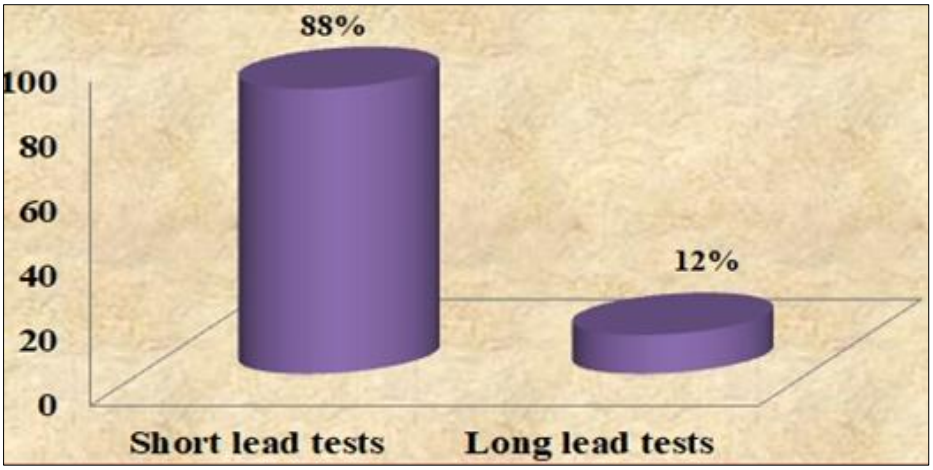

Fig 4: Bar diagram showing the distribution of short and long lead tests

Table 3: List of tests performed under each lab category with their respective defined TATs

Sl.no	Lab category	Name of the tests performed	TAT
1.	Hematology	CBC, Platelet count, Hb, PCV, Total WBC, DC, AEC, ESR, Reticulocyte count	90 mins
		Peripheral smear (PS) for cell morphology and PS for malarial parasite	180 mins
2.	Biochemistry	ALP, Albumin, ALT, AST, Blood Urea Nitrogen (BUN), Cholesterol, HDL & LDL Cholesterol, Triglycerides, Creatinine, Electrolytes (Sodium, Potassium and Chloride), Glucose (Random, Fasting and Postprandial), Glycosylated Hb (HbA1C), Total bilirubin, direct and indirect bilirubin, Total protein, Troponin –T, Urea, Uric acid, Amylase, lipase, Calcium, Phosphorus, CPK	90 mins each
3.	Serology	VDRL, HIV I & II Antibody, HbsAg, HCV Ab, Dengue IgG&IgM	90 mins each
4.	Coagulation	PT, APTT, BT, CT	`90 mins each
5.	Immunohematology	Blood grouping, Coomb's test	90 mins each
6.	Clinical pathology	Routine urine analysis, Routine stool analysis, Body fluid analysis, Semen analysis	180 mins each
		Stool for occult blood, Urine pregnancy test	90 mins each
7.	Nephelometry	C- Reactive Protein (CRP)	90 mins

Table 4: Monthly distribution of the accessions achieving TAT

Sl.no	Lab category	No. of accessions achieving TAT						Total
		Jan	Feb	Mar	Apr	May	Jun	
1.	Hematology	607	705	881	651	475	438	3757(97%)
2.	Biochemistry	858	921	1156	814	640	624	5013(99%)
3.	Serology	231	326	398	493	271	273	1992(100%)
4.	Coagulation	139	161	137	174	226	258	1095(100%)
5.	Immunohematology	71	100	101	51	43	20	386(95%)
6.	Clinical pathology	191	224	329	146	118	84	1092(84%)
7.	Nephelometry	40	31	39	239	155	434	938(100%)
Total		2137	2468	3041	2568	1928	2131	14273(97.4%)

Out of 14652 accessions, 14273 (97.4%) accessions achieved the defined TAT. 100% TAT was achieved in serology, coagulation and nephelometry lab categories (Table 4).

Table 5: Monthly distribution of the accessions not achieving TAT

Months	Total no. of accessions	No. of accessions not achieving TAT	Frequency (%)
Jan	2205	68	3.1
Feb	2541	73	2.9
Mar	3119	72	2.5
Apr	2640	78	2.7
May	1982	54	2.7
Jun	2165	34	1.6
Total	14652	379	2.6

Out of 14652 accessions, 379 accessions from different lab categories did not achieve the acceptable TAT & the outlier rate accounted for 2.6%. The outlier rate showed a decrease from 3.1% in January to 1.6% in June (Table 5).

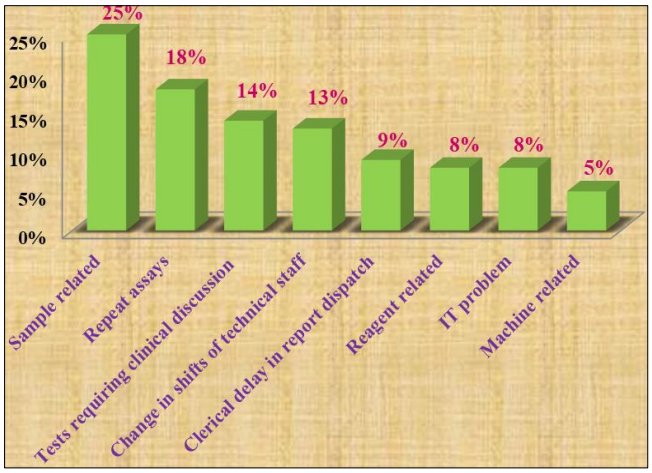

Fig 5: Bar diagram showing the various reasons for delay in TAT

Among the various reasons for delay in TAT, 25% of the total delayed TAT was due to sample related factors (Problem samples) followed by repeat assays (18%) and tests requiring clinical discussions (14%) (Fig 5).

The various measures which were taken to improve the TAT are as follows:

1. Regular training and monitoring of the nursing staff and the technical staff involved in blood sample collection significantly decreases the number of problem samples.
2. Sensitizing the nursing staff and clinicians about the importance of mentioning the clinical history on TRF helps in avoiding the delayed TAT due to repeat assays.
3. Proper communication with the clinicians helps in speedy procurement of history in cases requiring clinical correlation.
4. Increasing the technical staff during peak hours when the sample load is more helps in improving TAT. It also avoids the clerical delay in data entry.
5. Collecting regular feedbacks from the patients as well as the clinicians helps to check the points of delay in TAT.
6. Maintenance of weekly and monthly reagents and consumables inventory.
7. Strict vigilance of quality assurance.
8. Regular lab review meetings
9. Regular auditing of TAT data (daily and monthly basis) helps in evaluating the factors affecting TAT.

Discussion

There is a paucity in the existing literature about the determination of TAT in laboratories for regular monitoring of quality services especially by developing an in-house software performance indicator. Our study has discussed extensively on the monitoring of TAT and has also suggested measures to improve the TAT. In a study conducted in 1998, 41.1% of laboratories defined TAT as the time taken from receipt of a specimen in the laboratory to reporting of the test result, 27.0% defined it as the time taken from the test order to reporting of the result, and 18.2% defined it as the time taken from collecting a specimen to reporting the result [6]. In our study, TAT was defined as the time taken from the specimen accession in lab to report dispatch/ release.

Most of the laboratories have used up to four analytes only in calculating delays in reporting time [7], however in our study we have included 54 analytes. In a study by Bhatt RD *et al*., consultation time played a major role for delay in predetermined TAT covering 48% of the total whereas sample related issues contributed around 17% to the total delay in TAT. 48 % of the reports were delayed due to time wasted in reconfirmation of obtained critical values of test. Mostly reconfirmation was done by repeating the tests or informing laboratory consultant before releasing such reports [8]. In our study, sample related factors, repeat assays and tests requiring clinical discussions contributed to 25%, 18% and 14%ofthe total delay in TAT respectively.

In a study by Cakirca G *et al*, insufficient volume (48.8%) was the most common factor leading to specimen rejection in the hematology laboratory and the second common factor in the biochemistry laboratory (45.6%) [9]. Similarly, this factor was the second common cause of specimen rejection in several studies [10-13]. The various causes of sample rejection in our study included unlabelled/ mislabeled samples, hemolyzed samples, clotted samples, samples with gross turbidity, samples collected in improper containers/ vacutainers, low/ insufficient volume of samples, samples not matching the TRF, broken/ leaking sample container. Insufficient volume of samples constituted the majority of problem samples in our study.

In our study, very low figure of outlier rate was seen accounting for 2.6% (Table 6) compared to other studies [2, 3, 8, 14, 15]. However, low figures do not justify the delays to be acceptable. Therefore, we implemented many corrective and preventive measures which reduced the outlier rate from January to June from 3.1% to 1.6% respectively.

A study performed by Chauhan KP *et al*. suggested that percentage of specimens exceeding TAT in 2011 was 6.4% which decreased to 4.6% by year 2012 [16].

Table 6: Comparison of the outlier rates of our study with others

Study	Outlier rate
Wankar AD [2]	45.35%
Steindel SJ, Novis DA *et al* [14].	10.4%
Bhatt RD *et al* [8].	9.8%
Killol Nathubai Desai *et al* [3].	6.8%
F. Bilwani *et al* [15].	2.03%
Present study	2.6 %

Very few studies in literature have evaluated the causes for delay in TAT and have suggested measures for improving the same. Regular lab review meetings, strict vigilance of quality assurance, regular training of technical staff, maintenance of inventory and consumption details, regular feedbacks from clinicians and patients, proper communication and speedy procurement of clinical history significantly helped us in improving the lab TAT.

Conclusion

Efficient lab performance depends on achieving rapid TAT. Regular monitoring of TAT data helps in evaluating the reasons for delayed TAT. Regular lab review meetings, strict vigilance of quality assurance, maintenance of inventory and consumption details, regular feedbacks from clinicians and patients, speedy procurement of clinical history significantly helps in improving the lab TAT.

Acknowledgement

Nil

Conflict of Interest

Nil

Funding Statement

Nil

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