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Original Article

Pathology Section

Root Cause Analysis (RCA) of Prolonged Laboratory Turnaround Time in a Tertiary Care Set up

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ABSTRACT

Introduction: Among the multitude of daily administrative problems which are faced by the modern hospitals today, prolonged Turnaround Time (TAT) of laboratory investigations is a crucial one, which affects patient care as well as patient satisfaction adversely.

Aims and Objectives: The specific objectives were to observe the TAT of common laboratory investigations, to identify cause of increased turnaround time and to formulate action plans to rectify increased TAT.

Methodology: An observational, RCA study was performed on 100 randomly selected patients. A separate group of 50 patients were assisted to get their investigations done and to reduce the time intervals without actively interfering with the steps. The results which were obtained were accepted as standards. Root cause analysis of the delays which were detected in TAT was done. Time intervals of TAT in the two groups were compared by 2 tailed t-tests done for equality of means.

Result and Analysis: All time intervals were high in the study group and they were found to be statistically significant ($p<0.05$) within a 95% confidence interval of the difference. The maximum time which was needed in the control group was within the interval between the prescription of the investigation by the doctor and writing of the requisition by the Out-patient Department (OPD) staff. For the study population, it was the interval between the writing of the requisition by the OPD staff and the reaching of the patient at the central Laboratory. The standard deviation (27.665) and range (102) were also exceptionally high for this interval in the study group.

Conclusion: This study revealed that easy to implement administrative steps would help in reducing the TAT significantly and in improving the quality of services of the central laboratory. These include the setting up of sample collection counters at the outpatient department (OPD) and inpatient department (IPD), employment of minor methods like printing the directions for reaching the laboratory on the OPD ticket, the start of a single prick policy, declaring central laboratory as a separate department and integration of the administrative control under one authority.

Keywords: Laboratory Turnaround Time, Root Cause Analysis, Pathology Investigations

INTRODUCTION

Among the multitude of daily administrative problems which are faced by the modern hospitals today, prolonged Turnaround Time (TAT) of laboratory investigations is a crucial one, which affects patient care as well as patient satisfaction adversely and substantially. Health care processes are difficult to define, because of their complexity [1]. Assessing time definitions in clinical processes can help in analyzing workflows in hospital information systems (HIS) and in identifying weak points [2]. Due to increasing costs of health care, it is important to improve the efficiency of clinical workflows.

When process times are analyzed, it is important to be aware of the different definitions which are used for time intervals. One of the most common measures of laboratory or pathological services is the turnaround time (TAT), which has been frequently used since 1980, to quantify the time taken for doing laboratory tests in an objective manner [3]. The first reference dates back to 1971 and it has described TAT as the time interval between electrocardiogram printing and placement of the printout in the patient chart [4]. In the laboratory workflow, TAT is an important indicator of performance [5] and it is even seen as a "necessary condition for trust between patient and physician" [6]. Turnaround time in Pathology comprises of a fixed component, which is assay dependent (that is, the time which is required for analyzing a specimen), and a variable component (the time which is taken to receive the specimen and order, and to post the result) [7].

Root cause analysis (RCA) is a method of problem solving, that tries to identify the root causes of faults or problems that cause operating events. Root cause analysis is a valuable management tool that can be readily learned by managers as well as frontline personnel. It can be conducted at several levels of depth and complexity [8, 9].

Root Cause Analysis (RCA) is defined as "an objective, thorough and detailed methodology which is employed to determine the most probable underlying causes of problems, complaints and undesired events which occur within an organization, with the aim of formulating and agreeing with corrective actions, to at least mitigate, if not eliminate those causes and to so produce a significant, long term performance improvement" [10].

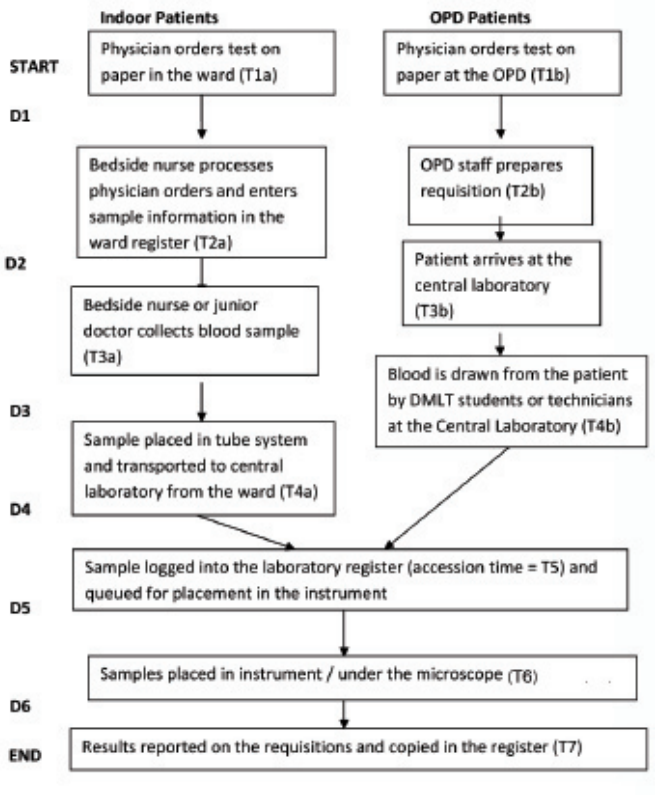
The objectives of the present study were to observe the TAT of common laboratory investigations at the central Laboratory of a tertiary care, state government medical college and hospital, to identify the cause of increased TAT, and to formulate action plans to rectify the increased TAT, if any was detected.

METHODOLOGY

The present study was a descriptive, cross-sectional study which was conducted on patients who attended the Medicine and Surgery OPD and on those who were admitted to the Medicine and Surgery In-patient Department (IPD), of a tertiary care, state government medical college and hospital. One hundred patients (25 each from the Medicine and Surgery OPD and IPD) were selected by using a simple random sampling technique. Only those patients were included, who were advised Complete Blood Count (CBC) and/or Urine Routine examinations, who were unrelated to any staff member of the hospital, whose test order was not marked as 'urgent' or 'emergency' and whose tests were performed free of cost i.e. there was no need to go to the cash counter for paying

charges for the test. The TAT of Pathology investigations in the selected patients was observed and the RCA of the delays which were detected in TAT was done. Salient recommendations were formulated on the basis of the findings.

A flow chart was created to identify key steps in the laboratory process [Table/Fig-1]. This allowed the measurement of seven events (i.e., six time intervals, D1 to D6 [Table/Fig-1] and overall TAT.



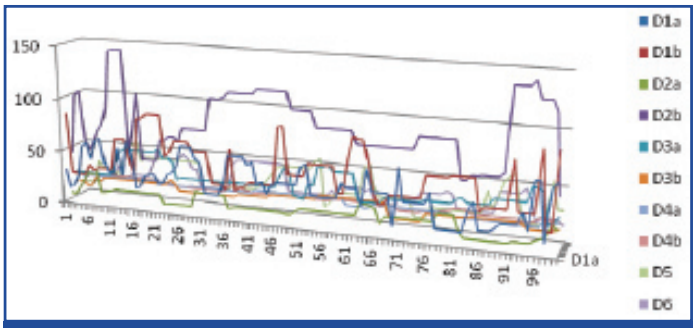
[Table/Fig-1]: Key steps in the laboratory process

The existing process and time which was required for final delivery of the report to the ward in case of indoor/admitted patients and also, receipt of the report by the OPD patients were also studied.

Ten groups of five patients from different departments and wards were accompanied by volunteers who helped the patients to get their investigations done. The volunteers tried to reduce the time intervals as far as possible, without actively interfering with the steps. The results which were obtained were accepted as standards or controls [Table/Fig-2].

The 100 cases which were studied and their samples were traced passively by using a time motion study. The patients, their accompanying persons and concerned administrative key persons were interviewed directly for obtaining necessary information. The results which were obtained for these 100 cases were compared with the standard or control time intervals [Table/Fig-3 and 4].

The data was collected in an MS Excel sheet and it was analyzed by frequency distribution and descriptive statistics, along with other parametric and non-parametric tests accordingly, by using Epi-info 7 and SPSS, version 14.Chikago.inc.



[Table/Fig-3]: The time intervals studied in the 100 cases

Time Interval	Minimum Time (Minutes)	Maximum Time (Minutes)	Range	Mean (Minutes)	Standard Error of Mean	Standard Deviation of Mean	
D1a	12	65	53	38.28	1.580	15.799	n=100
D1b	20	91	71	51.32	2.021	20.206	95% Confidence Interval and Confidence Limit
D2a	5	29	24	13.74	0.636	6.364	
D2b	45	147	102	91.16	2.766	27.665	
D3a	21	55	34	35.55	0.993	9.925	
D3b	11	26	15	18.71	0.393	3.927	
D4a	16	23	7	19.57	0.201	2.011	
D4b	16	23	7	18.95	0.189	1.893	
D5	10	58	48	29.53	1.333	13.325	
D6	15	45	30	27.32	1.065	10.652	

[Table/Fig-2]: Descriptive statistics of the 100 cases

Time Interval	t-test for Equality of Means				95% Confidence Interval of the Difference		
	t- value	Degree of Freedom	Significance (2-tailed)	Mean Difference	Standard Error Of Difference	Lower	Upper
D1a	17.755	102.209	0.003	28.280	1.593	25.121	31.439
D1b	12.835	104.837	0.002	26.320	2.051	22.254	30.386
D2a	13.518	105.268	0.012	8.740	0.647	7.458	10.022
D2b	27.456	100.053	0.001	76.160	2.774	70.657	81.663
D3a	20.289	107.002	0.002	20.550	1.013	18.542	22.558
D3b	19.723	138.711	0.010	8.710	0.442	7.837	9.583
D4a	26.554	130.713	0.011	7.570	0.285	7.006	8.134
D4b	32.327	125.085	0.009	8.950	0.277	8.402	9.498
D5	14.491	103.493	0.002	19.530	1.348	16.857	22.203
D6	11.363	105.973	0.008	12.320	1.084	10.170	14.470

[Table/Fig-4]: Comparison of the six time intervals between the case and control groups

Time Interval	Minimum Time (Minutes)	Maximum Time (Minutes)	Range	Mean (Minutes)	Standard Error of Mean	Standard Deviation of Mean	
D1a	8	12	4	10.00	0.202	1.429	n=50
D1b	21	29	8	25.00	0.350	2.474	95% Confidence Interval and Confidence Limit
D2a	4	6	2	5.00	0.114	0.808	
D2b	13	17	4	15.00	0.202	1.429	
D3a	13	17	4	15.00	0.202	1.429	
D3b	8	12	4	10.00	0.203	1.429	
D4a	10	14	4	12.00	0.201	1.429	
D4b	8	12	4	10.00	0.202	1.429	
D5	8	12	4	10.00	0.201	1.429	
D6	13	17	4	15.00	0.202	1.429	

[Table/Fig-5]: Descriptive statistics of the 50 controls

RESULTS AND ANALYSIS

The age of the study population ranged from 19 to 85 years, with a mean of 41.7 years. Male and female patients accounted for 52% and 48% of the study population respectively. Complete Blood Count (CBC) and Urine Routine examinations, the two most commonly advised pathological tests, were studied for their turnaround times (TATs).

CBC was advised in 89% of the study population and 46% were advised Urine Routine Examination. Eighty eight percent of the patients were also advised some other investigations which were mostly biochemical tests. [Table/Fig-2] shows the descriptive statistics of the 100 cases. Maximum time which was needed in almost all of the cases was between the preparation of test requisition and the reaching of the patient at the central laboratory.

[Table/Fig-2] shows the time intervals studied in the 100 cases. [Table/Fig-5] shows the descriptive statistics of the 50 control or intervention cases.

[Table/Fig-6] shows the parameters studied and their values along with the control values for each. Please refer to [Table/Fig-1] for further clarifications about the parameters.

Time Intervals	Time interval between	Range (in minutes)		Mean (Minutes)	Control (Minutes)
		Minimum	Maximum		
D1a	T2a and T1a	12	65	38.2	10
D1b	T2b and T1b	27	91	51.3	25
D2a	T3a and T2a	05	29	13.7	05
D2b	T3b and T2b	40	147	91.6	15
D3a	T4a and T3a	21	55	35.5	15
D3b	T4b and T3b	11	26	18.7	10
D4a	T5 and T4a	16	23	19.5	12
D4b	T5 and T4b	14	20	18.9	10
D5	T6 and T5	10	58	29.5	10
D6	T7 and T6	15	45	27.3	15
Total		171	559	344.2	127

[Table/Fig-6]: Parameters studied and their values along with the control values for each

The maximum time which was needed in the control group was in D1b i.e. the interval between prescription of the investigation by the doctor and the writing of the requisition by the OPD staff for the said investigation. But for the study population, the maximum time which was needed was in D2b i.e. the interval between writing of the requisition by the OPD staff and the reaching of the patient at the central Laboratory. The standard deviation (27.665) and range (102) were also exceptionally high for this interval in the cases group.

[Table/Fig-4] shows the comparison of the six time intervals between the case and control groups of 100 and 50 patients respectively.

The above [Table/Fig-5] shows that all the time intervals, both in case of the OPD and IPD cases, were high in the study group in comparison to the control group and they were found to be statistically highly significant ($p<0.05$) within a 95% confidence interval of the difference.

The time motion study and direct interviews revealed the following: The manning and control of Pathology subunit was undertaken by the office of the Medical Superintendant cum Vice Principal (MSVP); whereas those of the Microbiology and Biochemistry subunits were undertaken by the respective departments of the Medical College.

In the same complex of central Laboratory, in three separate rooms, a single patient was pricked thrice if he/she needed tests for haematology (say, blood RE), microbiology (say, malaria antigen) and biochemistry (say, blood sugar, urea or creatinine).

These three reports were to be collected by the patients from three different tables and may be at variable time intervals [Table/Fig-7 and 8].

The following were the mean differences in time intervals of TAT between the study group and the control group and the causes, along with their suggested solutions.

The extent to which improvements in laboratory turnaround time enhance patient outcomes is still unclear [11]. A critical issue is clinicians' capacities in responding to, and making clinical use of faster results. The limited data which are available to date are not encouraging. A UK study which investigated the impact of ward computers which allowed access to laboratory results, found that 45% of urgent requests for biochemistry tests from accident and emergency wards, and 29% from inpatient wards, were never accessed. Of the results which were never read, 3% were assessed as necessitating an immediate change in patient management. [12]. Clinicians report dissatisfaction with current tracking and follow up of test results [13]. So, unless clinicians' behaviours change, for utilizing faster results, we face the risk of over optimizing a single system. Additional system features such as e-mail inboxes which post important results to clinicians directly, or computer alerts which highlight urgent results, may help in supporting a better test management [14].

CONCLUSION

The present study arrived at the following conclusions: The Turn-around Times of investigations which were performed at the central Laboratory, especially the pre and post-analytical steps, were prolonged and these were statistically significant.

In the observed TAT of the study population, maximum time needed was in the interval between writing of the requisition by the OPD staff and the reaching of patient at the central Laboratory. Hence, employment of minor methods, like printing the directions for reaching the laboratory on the OPD ticket, would substantially bring down the TAT and subsequently increase patient satisfaction.

Time Interval	Mean Difference	Standard Deviation of Mean of study cases	Major Causes of delay	Suggested Solutions
D1a	28.280	15.799	1. No separate/designated staff for test order entry. 2. Paper-work involved.	1. Separate team of lab staffs may be posted at OPD and IPD for sample collection at a counter in a prominent position. 2. Clear instruction regarding requisition making at the point of advising tests. 3. Training of staff regarding importance of pre-analytical phase of tests. 4. Electronic test order entry software with bar-coding of samples may be started in the future.
D1b	26.320	20.206	1. Lack of clear instruction to patient about where requisition would be made. 2. Paper-work involved. (dedicated staff present)	
D2a	8.740	6.364	1. No separate / designated staff for phlebotomy or sample collection. 2. Usually treated as low priority job in comparison to therapeutic management of patients in the wards.	
D2b	76.160	27.665	1. Lack of proper direction to reach the Central Laboratory which is far away from the OPD. Those who are conversant reach early; hence the Standard Deviation is more. 2. Difficulty in identifying the Central Laboratory entrance. No sign-boards in vernacular languages [Table/Fig-8].	1. Sample collection counter at OPD. 2. Direction to the Central Laboratory may be printed on the OPD tickets. 3. Lab entrance should be made visible and more identifiable. Sign-boards especially in vernacular languages should be installed. 4. Existing social workers, volunteers and 'May I help you' desks should be utilized more efficiently.
D3a	20.550	9.925	1. Individual wards have separate staffs to transport the samples to the Laboratory. Hence availability of staff is less.	1. Single messenger can transport samples from a few closely located wards thus increasing the availability of staff.
D3b	8.710	3.927	1. No designated staff for phlebotomy or sample collection. 2. Senior technicians usually treat phlebotomy or sample collection as low priority job in comparison to actual testing.	1. Sample collection counter at OPD. 2. Training of staff regarding importance of pre-analytical phase of tests.
D4a	7.570	2.011	1. Laboratory staff accumulate samples and register them at a time. 2. Paper-work involved.	1. Accumulation of samples should be discouraged. 2. Training of staff regarding ill effects of sample accumulation and importance of post-analytical phase of testing. 3. Designated report delivery desk may be started with a separate staff. 4. Electronic test result approval system may be started in the hospital including the OPD within its domain.
D4b	8.950	1.893	1. Laboratory staff accumulate samples and register them at a time. 2. Paper-work involved.	
D5	19.530	13.325	1. Laboratory staff accumulate samples and test them at a time. Hence samples have variable waiting time which increased the Standard Deviation.	
D6	12.320	10.652	1. Laboratory staff accumulate the reports and dispatch them at intervals. 2. No designated staff is available for report delivery which is treated as a low priority job.	

[Table/Fig-7]: Mean differences in time intervals of TAT between the study group and the control group and the causes, along with their suggested solutions

[Table/Fig-8]: The reception counter at the Central Laboratory is devoid of any sign boards or directions in any vernacular languages

This study also revealed that certain easy to implement administrative steps would also help in reducing the TAT significantly and simultaneously improve the quality of services of the central Laboratory as a whole. These include the setting up of sample collection counters at the OPD and IPD, the start of a single prick policy and declaring central Laboratory as a separate department.

The TAT can be substantially reduced if minor assistance without active interference is provided to the patients. This was observed in the present study, among the control group of patients.

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