



Original Research Article

Turnaround time for common clinical chemistry examinations and root cause analysis for its delay

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ABSTRACT

Objectives: Measurement of turnaround time for common clinical chemistry examinations and performing root cause analysis for causes for inadequate turnaround time for examinations.**Materials and Methods:** The Turnaround Times (TAT) of common biochemistry tests ordered by physicians for OPD, IPD and ICU patients were evaluated. Various time periods were recorded, calculated and evaluated. Root cause analysis for delay in TAT was performed by Ishikawa fishbone method.**Results and Conclusions:** The study shows that average TAT for OPD patients was 22-23 hours, for indoor patient was 6-7 hours and for ICU patient was 7-8 hours. There was major contribution of report transport system in the total TAT, while actual analytical TAT contributed very small to over all TAT. The study shows that, lack of efficient sample and report transport, lack of man power and lack of electronic transport of report is root cause of delay in TAT.© 2019 Published by Innovative Publication. This is an open access article under the CC BY-NC-ND license (<https://creativecommons.org/licenses/by/4.0/>)

1. Introduction

Quality is the ability of a service to satisfy the needs and expectations of the customer. Laboratorians spend their most of time on discussion of quality to technical or analytical quality and are focusing on imprecision and inaccuracy goals but clinicians desire a rapid, reliable and efficient service delivered at low cost. However, timeliness which is expressed as TAT is often used by the clinicians as the benchmark for laboratory performance. Delays in TAT elicit immediate complaints from users while adequate TAT goes unremarked. Unsatisfactory TAT is a major source of complaints to the laboratory regarding poor service and consumes much time and effort from laboratory staff in complaint resolution and service improvement. Despite advances in analytical technology, transport systems and computerization, many laboratories have had difficulties improving their TATs.¹ Clinicians depend on fast TATs to achieve early diagnosis and treatment of their patients

and to achieve early patient discharge from hospital in-patient services. Delayed TATs also increases the frequency of duplicate samples sent to the laboratory and thereby increases the workload on the laboratory. Assessment and improvement of TAT is essential for laboratory quality management as well as ensuring patient satisfaction.²

2. Materials and Methods

2.1. Target sample

The turnaround times (TAT) of common biochemistry tests ordered by physicians for OPD, IPD and ICU patients were evaluated and performed by automated analyzer and evaluated. Labelling of the vacutainers by stickers was done at OPD, IPD and ICU. On label, only collection time of that particular sample was written and that made identity to that sample for measuring time at various steps.

The TAT data was measured from samples received by our laboratory from indoor, outdoor, and Intensive care unit during a period of August 2014 – November – 2014.

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2.2. Sample size

Samples size described in below table:

Table 1: Sample size among various sections

Location	Sample size
OPD	114
IPD	119
ICU	101

For measurement of TAT, it was classified into 3 phases:

1. Pre-analytical;
2. Analytical; and
3. Post-analytical.

The pre-analytical phase included:

Blood collection time recorded in observational sheet as in below Table 2, which include various time periods to be recorded was used to track sample status.

Receiving time of sample at Clinical biochemistry laboratory, recorded in LIS automatically when the sample entry was made at receiving window on arrival of sample.

The analytical phase included:

Centrifugation time of samples was recorded manually in printed sheet.

Separation time of samples was also recorded manually

Sample analysis completion time was recorded in LIS automatically when the sample analysis is completed at analyzer. It is retrieved from analyzer by LIS software.

The post-analytical phase included:

Reporting time of results to physicians recorded in LIS when report is printed for delivery.

1. Difference between various time period and total time was calculated by simple mathematical algorithms in Microsoft excel.
2. Percentage time contributed by particular phase to total time period was calculated.
3. Root cause analysis was performed for delay in TAT with the help of fish-bone diagrams. Causes are usually grouped into major categories to identify these sources of variation. In the diagram, the various causes are grouped into categories (such as equipment, materials or processes) and the arrows in the image indicate how the causes cascade or flow toward the non-conformity.³

How to Use the Tool?⁴

Follow these steps to solve a problem with Cause and Effect Analysis.

- Step 1: Identify the Problem
- Step 2: Work Out the Major Factors Involved
- Step 3: Identify Possible Causes
- Step 4: Analyze Your Diagram

3. Results

TAT for all the samples (both routine and emergency) for the outpatient and hospitalized patients were evaluated for 3 months. TAT was calculated from sample collection to report dispatch. The average TAT recorded in this study on the clinical biochemistry samples is described in Table 3.

The Master table of comparison of contribution of various examination steps to total TAT in various sections' sample is described in Table 4 and percentage contribution for the various phases among various sections in Table 5.

4. Discussion

The study concluded that Pre-analytical and Post-analytical phases were found to contribute approximately 75% to the total TAT. The TAT demonstrates the need for improvement in the pre-analytical and post-analytical periods. Some of the causes and suggestions for that improvement are discussed here.

4.1. Lack of man power

There were limited person for transporting samples from wards, ICU and OPD. Sometime relatives of patient come with samples to the laboratory and thereby it can take time for searching laboratory. Same scenario is observed with reporting of sample. Although there are two persons for transport of samples and taking reports but there is lack of dedicated system for that in ICU. There is dedicated system in wards so total average TAT is more in ICU then in IPD. Thereby pre-analytical and post analytical part contribute more in total TAT. This can be improved with the help of automatic transport system like pneumatic system. There has to be effectively working LIS and HMIS system between IPD, ICU and Laboratory. With such system reports can be provided readily when they are ready in analyzer and users can make entry of sample by themselves in IPD and ICU may reduce entry time. Thereby cost for manpower can be reduced if communicating system will be working efficiently.

Insufficient automated instruments to work with the sample load.

Currently only one automated instrument is there in laboratory that is ERBA XL-640. Because there is delay in purchasing instruments due to difficult procedure for purchasing instrument and limited funding provided by government, improvement in policy for purchase can help decrease TAT by expediting purchase of newer equipments.

No identification for urgent and routine sample from wards.

Currently samples are analyzed one by one regardless of whether they are urgent or routine, because majority of samples are labeled "urgent" indiscriminately. So that clinicians have to wait for report of urgent sample. Due to that line of management of patient may be delayed. Strict

Table 2: Observation sheet for record of TAT of various sections

Date	Sample i.d.	Collection time	Receiving time	Centrifugation time	Separation time	Analysis completion time	Report sending time
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Table 3: Average TAT for various sections

Average TAT for all examinations for various section	
Sections	Hours: Minutes
OPD	22 hours 28 min
IPD	6 hours 28 min
ICU	7 hours 27 min

Table 4: Master table of contribution of various examination steps to total TAT

Time period	OPD		IPD		ICU	
	Average Time taken (min)	% of total time	Average Time taken (min)	% of total time	Average Time taken (min)	% of total time
Receiving time	65	4.80	108	28.26	74	17.68
Centrifuge time	13	0.99	14	3.68	10	2.32
Aliquating time	19	1.39	17	4.40	14	3.39
Analysing time	218	16.06	125	32.59	99	23.70
Dispatching time	1043	76.79	121	31.60	221	52.77
Total time	1355		382		418	

Table 5: Master table of comparison of contribution of various phases to total TAT in various sections

	OPD	IPD	ICU
Pre-examination	5.79	31.93	20.00
Examination	17.45	36.99	27.09
Post-examination	76.79	31.60	52.77

institutional policy for labeling urgent sample only when required can improve TAT for REALLY URGENT samples.

4.2. Reflex testing

As per current scenario, laboratory is doing urea reflexly when S. Creatinine result is > 1.8 mg/dl. But there is no facility in instrument for identifying that automatically. So that technician and resident doctors have to put samples for completion of those reflex tests after completion of batch or when they are notified. This may lead to prolongation of TAT.

4.3. Repeat examinations

There may be delay in TAT when sample volume is insufficient for doing all test requested by clinicians or there is emptying of reagent in between analysis. If sample has clot, machine may not analyze it in running batch. There may be some contamination of sample come from IPD, ICU and OPD. So repeat examination is requested to clinician for that sample. Prompt information regarding critical values

and pre-analytical errors will be given to the wards so that repeat samples are processed without much delay.

4.4. Manual dilution of sample

There is limitation of linearity in current instrument. So certain samples exceeding that linearity limit have to be put after manual dilution of sample.

For that improvement, instrument with high linearity limit and facility for automatic dilution has to be purchased.

User may add some test after receiving and/or analyzing of sample. Currently, some of the tests are added when senior clinicians are in round and reviewing the laboratory request. Clear-cut guideline to junior staff in clinical departments regarding examination request can help reduce TAT in such cases.

Possible reasons for delay in TAT at NCH, Surat are shown as in fish-bone manner in illustration 1.

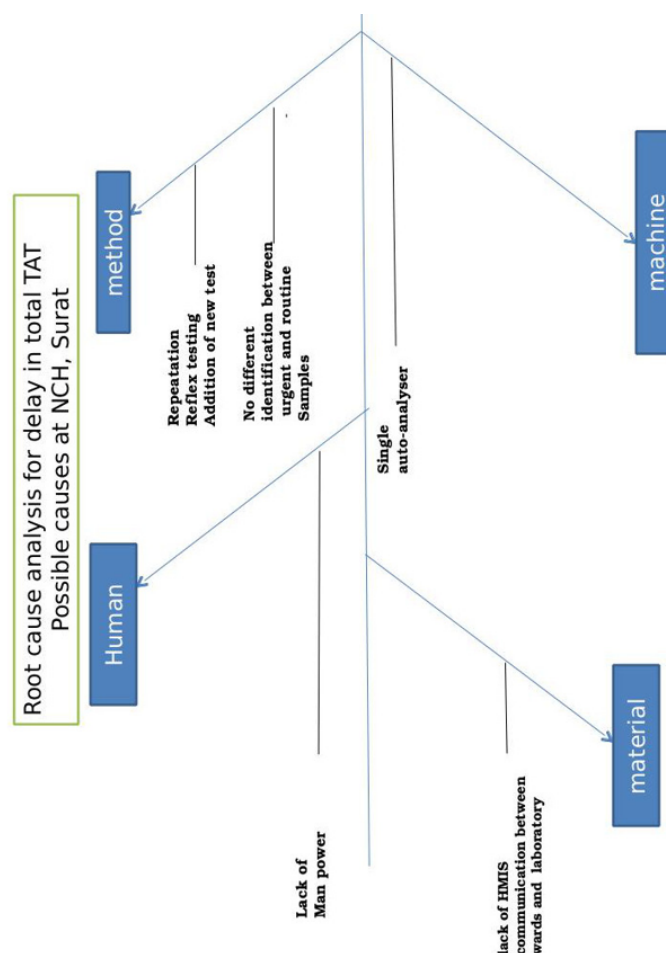


Fig. 1:

5. Conclusions

The study of turnaround time for clinical chemistry examination, conducted at Biochemistry section of New Civil Hospital Surat Laboratory Service at New Civil Hospital Surat found that average TAT for OPD patients is 22-23 hours with 3/4th time due to report transport, TAT for indoor patient is 6-7 hours with 1/3rd time due to report transport and TAT for ICU patient is 7-8 hours with 1/2 time due to report transport.

Surprisingly, the study shows that TAT of ICU is greater than IPD. Higher contribution of report transport time in ICU (50% of total TAT) as against 30% in Indoor patient explains the finding. There is no well defined system / persons for transport of report in ICUs, while Indoor reports are transported by two hospital staff regularly at regular interval.

This study is not based on brain to brain TAT. The study mentions total time from sample collection to report dispatch from laboratory. The study does not include time taken between clinicians orders of examination request and

actual time for sample collection. The study also does not include time between collection of reports and clinicians' review of reports.

Samples collected from wards for study were mainly from Medicine department so there may be some variation of TAT in other departmental wards depending on their resources. Stratification of samples, so as to distribute them across all departments and wads can change conclusions of the study.

Study was done between 9 A.M. - 6 P.M, for samples collected in ward and ICU. The reliability of the study can be improved if samples collected at night were also included in the study.

6. Source of funding

None.

7. Conflict of interest

None.

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