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Original Research

Delivering Quicker Reports for Laboratory Tests Ordered in Emergency Department

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ABSTRACT:

Prolonged turnaround time (TAT) of STAT emergency samples is the single most common cause of complaints about laboratory services all over the world. While the clinicians understandably desire quicker results for quicker clinical decisions affecting clinical outcomes, course and cost of treatment of these very sick patients; pathologists are frustrated by the unrealistic expectations of clinicians, excessive load of unnecessary STAT orders and delays outside laboratories affecting their TAT. This study was planned to find ways to improve TAT of emergency samples with the aim of quicker diagnosis, shorter stay in emergency, improved efficiencies of Emergency department (ED) and Laboratory (Lab), reducing hospital costs and improving patient experience. It was found that causes for delays most often lay outside lab. The remedy lay in correcting certain practices such as leaving drawn samples on bedside before transportation, drawing samples long after logging in Hospital information system, snags in Pnuematic tube system and delayed answering of lab calls in ED informing about critical results. Unnecessary ordering of tests as STAT increased the work load in lab. Other unexpected reasons for prolonged TAT were: non-cancellation of orders for rejected samples but waiting for arrival of a redrawn sample; and placing of future STAT orders for patients admitted from Emergency department. While the former resulted in prolonged Lab time, the latter resulted in prolonged Sample draw time and transport time as the hospital uses Pneumatic tube system for ED samples, but courier system for wards samples.

KEYWORDS: Emergency department (ED); Critical test; STAT tests; Critical result; Turnaround time (TAT); Length of stay; SWOT analysis; Root cause analysis; Fish bone diagram; Process mapping, PDCA; Efficiency of ED; Lab efficiency.

INTRODUCTION

Overcrowding and prolonged length of stay (LOS) in emergency departments (ED) are an increasing problem in most public hospitals[1,2]. EDs and their payers (Governments or private providers) are under pressure to reduce LOS, improve health outcomes, and reduce costs. Although the operations of emergency services are complex, several patient care decisions hinge on timely availability of lab results[1]. Clinicians depend on fast Turnaround times (TAT) of Laboratory tests to achieve early diagnosis and treatment of their patients and to achieve early patient discharge from emergency departments or hospital in-patient services. Hence faster Lab TAT results in curtailing general expenditure incurred by the exchequer. Delayed TAT 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[3].

Laboratories have traditionally restricted discussion of quality to analytical quality, focusing on imprecision and inaccuracy goals. Clinicians however are interested in service quality, encompassing total test error (imprecision and inaccuracy), availability, cost, relevance and timeliness[4,5]. Clinicians desire a rapid, reliable and efficient service delivered at low cost[6]. Of these characteristics, timeliness is perhaps the most important to the clinician, who may be prepared to sacrifice analytical quality for faster turnaround

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time (TAT)[4,5]. TAT is one of the most noticeable signs of a laboratory service and is used by many clinicians to judge the quality of the laboratory.[7] 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.

A College of American Pathologists (CAP) Q-Probes survey of ED TAT in 1998 showed low satisfaction rates concerning the laboratory's sensitivity to urgent testing needs and meeting physician need[8]. Laboratory TAT was felt to cause delayed ED treatment more than 50% of the time and also increased ED length of stay (LOS) over half the time. With the increasing interest in the extra-laboratory phases of the testing process, more laboratories are including TAT as a key performance indicator of their service[9,10]. Clinicians consider TAT from the time the test is ordered to results reporting, whereas laboratory professionals prefer to report 'Lab Time' i.e. from specimen receipt in lab to reporting of results as the TAT[3,11]. Non Analytical delays beyond the jurisdiction of the laboratory may be responsible for up to 96% of total TAT[12].

The present study was undertaken to evaluate the current turnaround times for samples from emergency department (ED) and attempt to shorten them with the aim of reducing time for diagnosis and treatment, reducing length of stay in ED, increasing patient satisfaction and improving efficiency of ED and Laboratory[3].

DEFINITIONS OF TURNAROUND TIME

Inspection of the literature reveals a variety of different approaches to definition of TAT. TAT can be classified by test (e.g. potassium), priority (e.g. urgent or routine), population served (e.g. inpatient, outpatient, ED) and the activities included. This last area is the greatest source of variation in reporting of TAT. The steps in performing a laboratory test were outlined by Lundberg, who described the brain to brain TAT or "total testing cycle" as a series of nine steps: ordering, collection, identification, transportation, preparation, analysis, reporting, interpretation and action[13,14]. The term "therapeutic TAT" is sometimes used to describe the interval between when a test is requested to the time a treatment decision is made[15-17]. Most laboratories restrict their definition of TAT to intra-laboratory activities, arguing that other factors are outside their direct control and that timing data for extra-laboratory activities are not readily available[18]. Such an approach will necessarily underestimate TAT since non-analytical delays may be responsible for up to 96% of total TAT[19,20]. In the ED, delay in review of results by clinicians is the greatest component of perceived TAT[18]. Intra-laboratory TAT can also vary in its definition with possible start points of sample receipt time, registration time, or analytical sampling time and end points of analytical completion time, result verification time, result transfer to electronic medical record time and report printing time.

Another classification of time periods separates the steps into the pre-analytical (order to preparation), analytical (analysis) and post-analytical (reporting to action) phases[21,22]. These divisions have often been used when classifying errors and delays and are sometimes used for description of TAT. There are differences between clinicians and laboratories in their definitions of TAT. In the 1998 CAP Q-Probes program, 41% of laboratories defined ED TAT as time of receipt in the laboratory until time of report, 27% as ordering of test to result reporting and 18% as specimen collection to reporting. However over 40% of physicians defined ED TAT as starting at physician request and only 9% at laboratory receipt.

There was better agreement between laboratories and physicians in the choice of endpoint with over 40% of physicians choosing when the physician gets the results as the end point and 50% when the ED gets the results. Similar results were seen earlier in the 1990 CAP Q-Probes survey with test ordering or phlebotomy the preferred start point and laboratory reporting or physician receipt the preferred endpoint for the majority of physicians[23].

In the case of TAT, the overall process is composed of multiple sequential steps, each with a minimum or fastest time possible. For example, if a centrifuge is set to 10 minutes spinning time, centrifugation can take no less than 10 minutes and may take longer if there are delays (e.g. balance problems). This means that Gaussian distributions for each of the individual steps or for the total TAT are not expected. It is thus inappropriate to use means and standard deviations as descriptors of TAT distributions. A non-Gaussian distribution with a positive skew (or tail to the right) is seen for TAT distributions,

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meaning that 'median' and 'tail size' are the preferred measures. Tail size can be quantified as the percentage exceeding a defined time (outlier rate) or as the time corresponding to a defined percentile of the distribution (e.g. 90th). This last measure is increasingly common in the literature and is referred to as the 90% completion time. Valenstein and Emancipator studied the performance of four measures of laboratory TAT: the mean, median, 90th percentile, and outlier rate[24].

For tests with long TATs, the most important quality of a TAT measure is high reproducibility, so that improvement in reporting speed can be distinguished from random variation resulting from sampling. The mean was found to be the most reproducible of the four measures, followed by the median. The mean achieved acceptable precision with sample sizes of 100–500 tests. For tests with normally rapid TATs, the most important quality of a measure is high sensitivity and specificity for detecting whether TAT has dropped below standards. The outlier rate was found to be the best measure of TAT in this setting, but required sample sizes of at least 500 tests to achieve acceptable accuracy[4].

In this study we measured Total as well as Lab Turnaround times in terms of 90th percentile of time taken and percentage of samples meeting the target TAT.

EXPECTATIONS OF TURNAROUND TIME

Over 80% of laboratories receive complaints about TAT, yet there is little agreement among clinicians on what constitutes acceptable TAT[21]. Service to the ED is a particular source of dissatisfaction with 87% of institutions reporting complaints[23]. Along with technological innovations (e.g. analytical, pneumatic tubes, computers) in the laboratory, physicians' expectations too have increased[25]. This may reflect greater attention to reducing patient LOS in the ED and greater clinician familiarity with the analytical speed of POCT devices such as blood gas analyzers. Unhappiness with TAT remains a problem today. A 2006 report of a CAP Q-Probes study of nursing satisfaction with hospital clinical laboratory services in 162 hospitals showed most satisfaction with result accuracy, phlebotomy courtesy toward patients and nursing staff, and notification of abnormal results[26]. Respondents were least satisfied with urgent test TAT, laboratory management responsiveness and accessibility, phlebotomy responsiveness to service requests, and routine test TAT. The most important aspect of laboratory service reported by nursing personnel was urgent test TAT.

Published data on TAT expectations are generally scanty. Clinician and laboratory staff expectations of ED TAT for haemoglobin, potassium, glucose and pO_2 measurements were surveyed as part of the 1990 CAP Q-Probes survey of 2763 clinicians and 722 institutions[23]. Of the different physician groups surveyed, generally surgeons had the fastest TAT expectations.[4] Among the multitude of daily administrative problems 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[27,28]. Assessing time definitions in clinical processes can help in analyzing workflows in hospital information systems (HIS) and in identifying weak points[29].

MATERIAL AND METHODS

This study involved studying of current processes and practices in Emergency Department (ED) and Laboratory (Lab) with regard to Lab samples for patients attended to in ED.

METHODS EMPLOYED INCLUDED:

- Direct observation of practices
- Interviews with all stakeholders
- Collection and analysis of data from Laboratory Information System (LIS)
- Data obtained from LIS in the form of Excel sheets was analyzed to calculate time taken in:

1. Draw Time: Physician's Order: Draw of sample (TAT 15 Minutes)
2. Transport Time: Draw of sample: Sample reaching Lab Reception (TAT 15 Minutes)
3. Lab Time: Lab Reception: Verification of Result (TAT 60 Minutes)

- Time taken was expressed as 90th percentile of time taken and percentage of samples achieving target TAT.
- Use of Process mapping, SWOT analysis, Fish bone chart and PDCA.

RESULTS

The study was conducted in a 400 bedded tertiary government hospital with a busy and well-structured emergency department that sends an average of 700 tests (around 70 samples) per day

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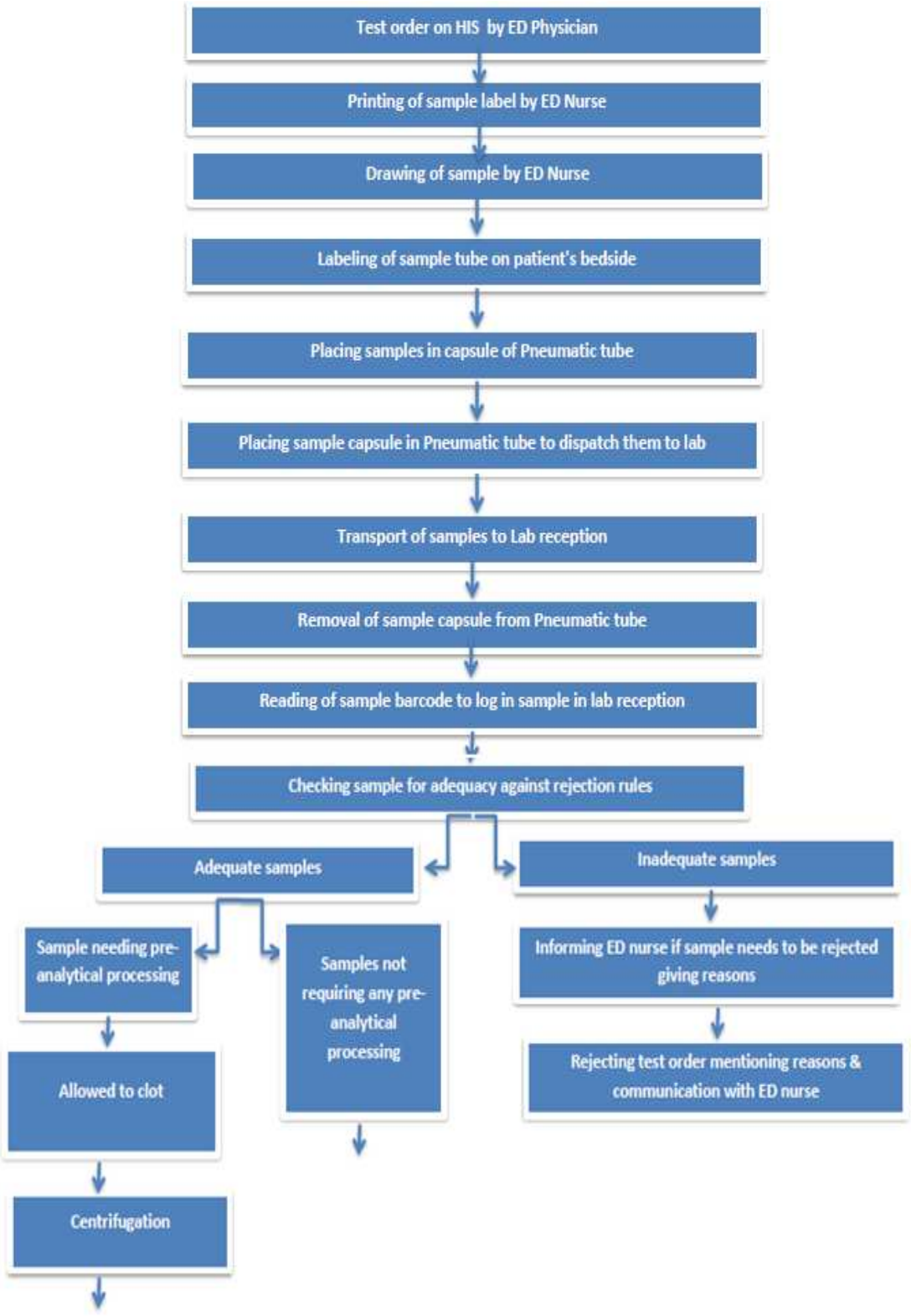
to Core lab. The hospital employs Hospital information system.

Process mapping was done for samples from Physician's order till result verification. (Fig. 1)



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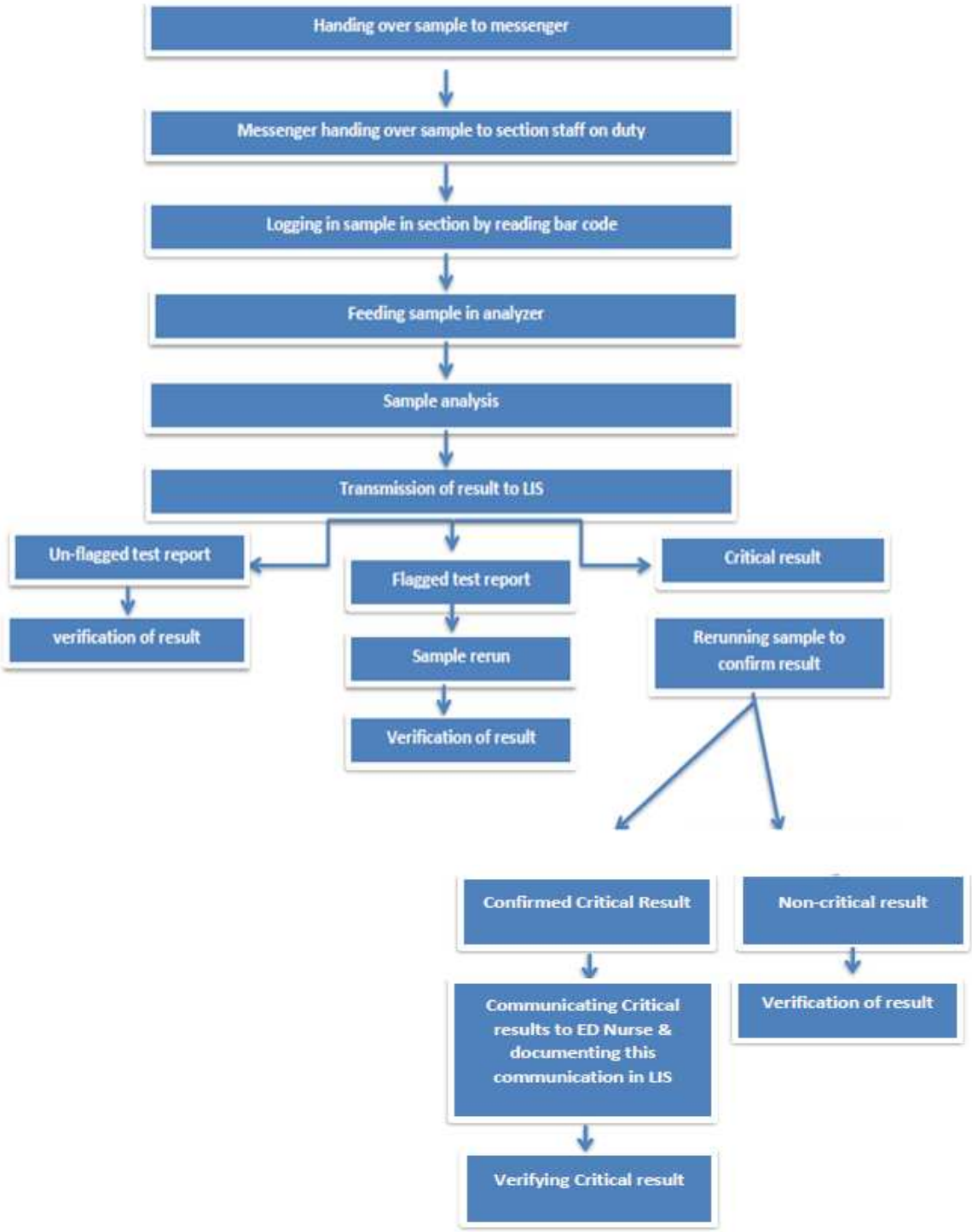

Figure 1.Process mapping flow chart.

1. ED Physicians place Test orders on Cerner in HIS (Physician's Order Time).
2. The ED Nurses draw patients' samples and print bar coded labels for Vacutainers. This time is captured as Sample draw time by Cerner.
3. The sample tubes are placed in double Biohazard bags and placed in buckets of Pneumatic Tube system for transport to Lab reception. The Pneumatic tube system is dedicated to ED alone and takes less than one minute to transport the sample. There is 1

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Technician assigned for ED samples on Lab reception who removes the samples from Pneumatic tube, logs them on reception using bar code reader: This time is captured by Cerner as Sample reception time in Lab.
4. Technician checks the samples for adequacy. If the sample is found inappropriate, based on rejection criteria, he rejects the sample after informing the ED staff via hotline and notes in Cerner the time and reason for rejection as well as the name and ID of staff informed.
5. Accepted sample undergoes pre-analytical processing in Lab reception and is handed over to Lab messenger for transport to relevant section of lab.
6. Section technician logs in the sample using bar code reader (Section log in time) and feeds the sample in analyzer. The results are transmitted directly to Cerner. Section technician verifies the result (Result Verification Time) and releases it for the clinicians to view on Cerner.
7. In case the result is flagged as Critically High or Critically Low, the sample is rerun and result is informed to ED staff via hotline. The ED staff reads back the result and receives a confirmation from calling technician. Technician records this information on LIS while verifying the result (Result Verification Time for Critical results).
8. Informed Nurse must inform the treating doctor within 20 minutes and record this information on Cerner.
9. The physician must act on this result within 30 minutes and record his actions on Cerner.
It was felt that shortening of ED sample time would shorten the stay in ED, improve ED efficiency and improve patients' satisfaction with hospital services.
Hospital target was to report 90% of STAT ED samples in 90 minutes: 15 minutes Order Time + 15 minutes Transport Time + 60 minutes of Laboratory time.

A study of sample TAT data for STAT samples from ED showed that total TAT (Physician's Order to Result Verification) was prolonged due to delays in Sample draw and sample transport. After direct observation and interviews with all stakeholders, SWOT Analysis was performed to map out strengths, weaknesses, threats and opportunities for the hospital. (Fig. 2)

Figure 2.SWOT analysis.

After brainstorming with all stakeholders, Fish bone analysis was performed to enlist the possible bottlenecks hindering timely verification of test results.
It was found that:
1. Clinical staff was unaware of the processes undertaken in the laboratory and vice versa.
2. The lists of Critical tests and Critical results were vast.
3. Lab was overburdened with unnecessary STAT orders.
4. Physicians placed future orders for STAT tests in ED for patients admitted to wards hence the Order-Draw times were prolonged.
5. Nurses sometimes drew samples long after logging in LIS & printing labels.
6. Nurses drew the samples but depended on ED Messengers to place them in Pneumatic tubes.

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7. Calls from lab were sometimes attended late affecting the time taken in telephonic communication of Critical results.
8. ED staff was informed about need to redraw 'Inadequate' samples but the Accession numbers for these samples were not cancelled. New sample arriving after 10-15 minutes was accepted on same accession number, thus prolonging the Lab TAT.

Interventions such as Process mapping, SWOT Analysis, brain storming, Root cause analysis, free & frequent communication; retraining & team efforts resulted in reducing the transport time to half.
The draw time and lab time too improved remarkably.

DISCUSSION

Patient overload in Emergency departments with the resultant shortage of beds has expectedly increased the demand for shorter Turnaround times for Lab tests. Quicker results usually result in early clinical decisions, early institution of life saving therapies or discharge and thereby a shorter stay of patient in Emergency room. This higher bed turnover translates into better patient experience and better revenues for the hospital and laboratory. However, physicians are often unaware of the Lab processes involved in sample analysis and have unrealistic expectations from laboratory. Unnecessary load of STAT samples or Critical tests overloads lab staff and can potentially compromise quality. STAT orders must be placed only when patient's condition demands lab result within 60 minutes in order to make important clinical decisions. Clinicians must resist the temptation to order STAT tests for other considerations. A shorter list of Critical tests prevents overloading of laboratory and results in quicker results of tests that are critically important in saving patients' lives. Even from a clinician's point of view it is preferable to have an early report of Troponin rather than that of Lipid profile.
While a hospital may have the best technologies such as Pneumatic tube system and flawless Standard operating procedures (SOPs), it is important for ED Charge Nurses to ensure that the Nurses are following the SOPs and not leaving the samples on bedside of patients. It is vital that Head of ED clearly conveys his expectations to the clinicians and nurses. It is illogical to place Future STAT orders on HIS.

Laboratory managers must communicate their vision clearly to their staff and share the monthly turnaround time data with them. It is equally important to have monthly Clinico-pathological meetings in order to remove communication gaps. One great procedure being followed in this hospital is the documentation of the time of communication of Critical results to physician by Nurse and the time at which Physician took action on this report. It would be worthwhile to audit the number of patients who benefited from Critical results/ Critical test results called up by the laboratory. Laboratories should seriously consider having a call centre for communication of such results in order to save precious technician-time.

Some good manoeuvres to improve Turnaround times in laboratories are following techniques and interventions:

- Developing a common understanding of the process to map every step and noting the time taken eg. 1m labelling, 2m receiving, 8m centrifugation, etc.
- Focusing on wasted motion such as walking, waiting, redundant steps, etc.
- Sharing reporting templates and explaining to all stakeholders how they would form the basis of an effort to improve TAT performance.
- Meeting with staff, management, stakeholders and leadership to create a "common vision" of what the reports are for, how they will be used and what to expect.
- Fixing accountability.
- Reinforcement by leadership and stakeholders to reinforce the importance and recognizing the efforts and improvements.
- Setting a realistic time frame.
- Having regular discussions with staff about results and sharing their ideas.
- Looking for variances in performance between sites, shifts and individuals.
- Communication, investigation and explanation of outlier(s) by staff.
- Making it the expectation that all staff would improve.
- Continuous re-evaluation.
- Making the best performers talk with the worst performers.
- Celebrating improvements.
- Staff retraining.
- Counselling staff with poor performance
- Sharing of experience of well performing staff.

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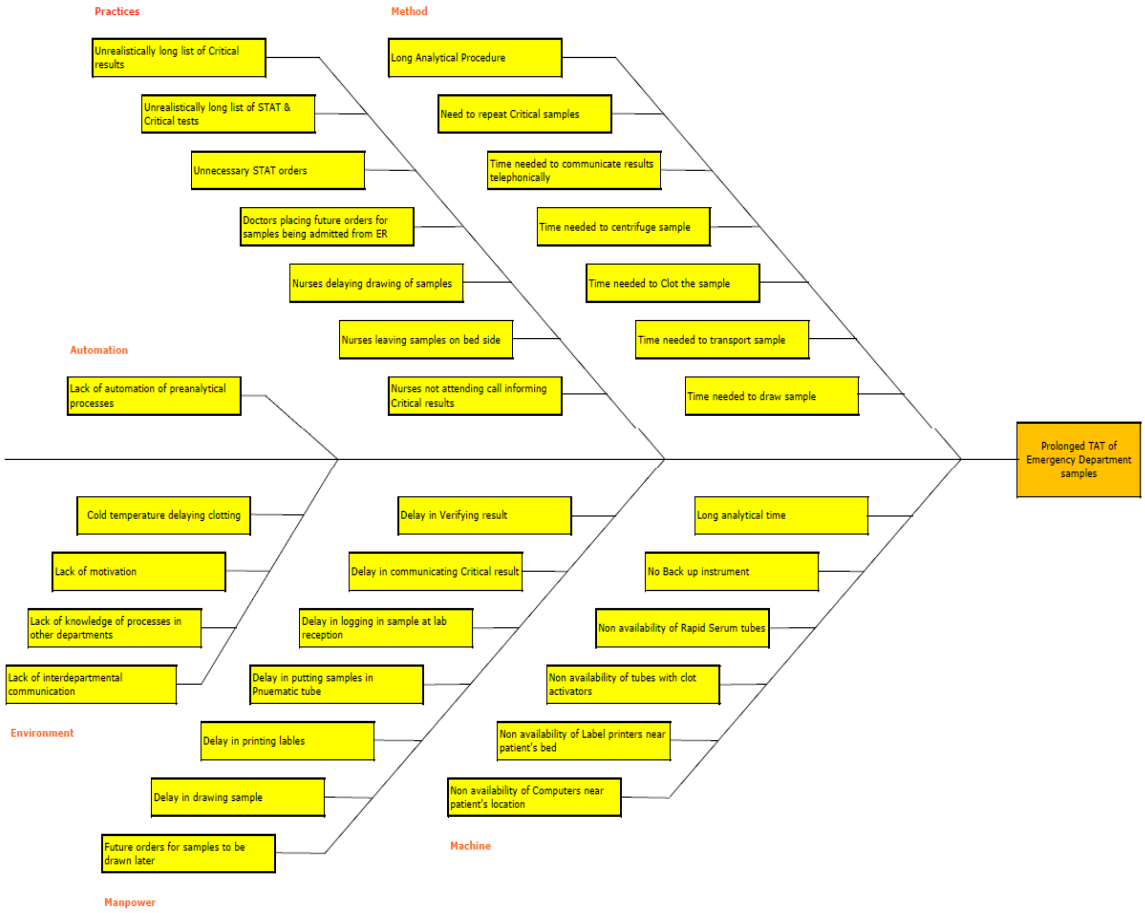
- Consistent and transparent in sharing of successes and failures with Lab and ED staff and managers.
- Celebrating days of no outliers.
- Purchasing Stat Spin centrifuges to reduce "spin" time (3 minute spin).
- Rapid Serum tubes in ED requiring 5 minutes Clotting and 3 minutes Centrifugation times (as against 30 minutes plus 10 minutes for regular tubes).
- Locating the Stat Spin centrifuges in Lab receptions.
- Backup instruments.
- Re-evaluating who should answer phones
- Displaying of pending TAT monitors in Laboratory to offer visual clues to ensure that technicians focus attention on stat requests.
- Revision of work schedules to match manpower to workload.
- Management of break and lunch times to maintain appropriate workforce in the laboratory.
- Modification of auto-validation rules for results so that individual test results were released as they were completed instead of when ALL tests were complete.

SOLUTIONS AND INTERVENTIONS

- A multispecialty meeting was arranged to discuss this issue. The detailed breakdown of time taken in various phases of sample TAT was presented to all the stakeholders and the team agreed to brainstorm ways to improve turnaround times. Direct discussions broke down turf barriers and the team agreed to work together to turn things around.

Annexure C-3 Fish bone chart



- Cause and Effect analysis was done using Fish bone chart (Fig. 3) and results were shared with all team members. Their suggestions were incorporated in the recommendations.

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- A PDCA (Plan, Do, Check, Act) project was formulated and adopted to monitor and improve Turnaround times of STAT samples from ED. 4 representative tests (Complete Blood Count, Prothrombin time/ International Normalized Ratio, Troponin I and Serum Electrolytes) were adopted for monitoring.
- Physicians were informed about lab processes involved in sample analysis and the essential analyzer time. They were informed about the need to have reasonable expectations from Lab so that TAT was not shortened at the cost of quality. They were also sensitized to the need to desist from ordering STAT unnecessarily so that lab is not overburdened and quality of results can be ensured.
- With the aim of reducing Technician time spent in re-running samples with Critical results and in telephonic communication of test results, trimmed down lists of Critical tests and Critical results were produced based on need for urgent clinical intervention. These lists were widely circulated *via* Emails, Circulars and LIS advisories.
- Lab reception staff was asked to cancel the Accession numbers of rejected samples promptly after informing ED staff.
- Lab technicians were provided with the telephone number of Nursing Supervisor on call who was assigned to receive and communicate results in case ED staff failed to attend three consecutive calls from Laboratory.
- Education sessions were held with ground level staff handling the samples and expectations and goals were communicated.
- Regular updates were provided to staff about the statistics and this inculcated a sense of participation and pride in Nurses, Technicians and Messengers handling the samples.
- Achievers were appreciated in public and in group emails as "employee of the week".
- Achievers were asked to mentor slow performers.
- Lab and ED were asked to investigate all TAT outliers of the previous day for remedial action rather than laying blame.
- TAT Monitor was also displayed on computers of all concerned Managers. Samples were highlighted Yellow when half the expected TAT was over and Red when 90% of expected TAT was over. These visual clues were appreciated by the staff running samples.
- These interventions resulted in reducing the transport time to half! The draw time and lab time also improved remarkably, thereby improving the Total TAT from physician's order till result verification.
- Hospital should consider the following:

1. Using Rapid Serum tubes for ED samples which need shorter time for clotting and centrifugation.
2. Setting up a call centre in Lab to save technicians' time spent on phone informing about Critical results or need to send a repeat sample.
3. Lab would greatly benefit from full automation of pre-analytical and analytical processes.
4. Displaying TAT Monitor on LCD screens in ED, Lab reception and in Core Lab with colour-coded status of all STAT samples from ED.

CONCLUSIONS

Shorter Turnaround times of Lab result is quicker diagnosis, faster clinical decisions and better patient care. Timeliness of laboratory results improves physicians' efficiency, shortens LOS in Emergency department, improves patient's perception about hospital services and improves trust in laboratory services. Despite technical, transport and information technology improvements in recent decades, TAT continue to be a cause of customer dissatisfaction with the laboratory service. Laboratory staff can feel frustrated when the effects of improvements in intra-laboratory TAT are diluted by pre-analytical and post-analytical factors seemingly outside their control. Observations such that 45% of the results for urgent laboratory tests requested by the ED were never accessed or were accessed too late do little to encourage efforts by the laboratory to provide a faster service. Clinician TAT expectations that are unrealistic or infeasible are also a source of friction. A better communication of processes, expectations and limitations, sensitization of all concerned staff, regular monitoring and better use of technology can yield quicker and reliable results. There is a need for well-designed studies of the effect of laboratory TAT on patient outcomes.

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