ISSN: 2536-7153 SJMLS

Sokoto Journal of Medical Laboratory Science 2023; 8(1): 96 - 107

SJMLS - 8(1) - 012

Patient Turnaround Time: Concern of Medical Laboratory Scientist

Ige Ilesanmi Paul, Mokwenye Victoria, Obadire Samuel Olalere*
Medical Laboratory Department, Achievers University, Owo, Ondo State, Nigeria [1], Medical Laboratory Department, Igbinedion University, Okada, Edo State [2], Medical Laboratory Department, Federal Medical Centre, Birnin Kudu, Jigawa State, Nigeria [3].
Author for Correspondence *: sanmi2sure@gmail.com/+234-706-289-6623.
https://dx.doi.org/10.4314/sokjmls.v8i1.12.

Summary
When a company that experienced a period of poor performance moves into a period of a financial recovery, it's called turnaround. It refers to time of recovery of a nation or region's economy after a period of recession or unproductivity. Turnaround time (TAT) is the duration of a process from initiation to completion, which can significantly be improved with an automated workflow solution. Doctors frequently used TAT as the standard for laboratory performance, way to communicate timeliness, a useful marker of laboratory efficiency, as a quality indicator to evaluate the effectiveness, efficiency of the testing process, and as clinicians and patients' gratifications. *Ordinarily,* turnaround time (TAT), can be defined *as* the time interval from the period of start of a process to the time of completion of the same process. It is the total amount of time spent by a process in the system, which can either be a *waiting time* or the time for executing the process/task. Since there's no perfect/precise definition of TAT, therefore, different definitions can be used based on the process or task to be carried out. For laboratory personnel, it would be from the time of receipt of sample in laboratory till report is generated after validation. However, it can be characterized based on the investigation performed (e.g. Full Blood Count, Haemoglobin, Potassium), type of patient attended to (e.g. Emergency Department, Intensive Care Unit, Wards, Out Patient Department etc.), degrees of significance (e.g. stat, urgent or routine) and the activities included (e.g. from the time of collation/receipt of sample or from the time of receipt of sample in laboratory). Factors affecting TAT can be grouped into pre-analytical, analytical and post-analytical. Adapting to an automated process, tracking of end-to-end process, drafting a more distinct process and multitask trained staffing are the methods to achieve good laboratory TAT.

Keywords: Turnaround Time (TAT), Laboratory, Performance, Quality.

Introduction

Turnaround Time (TAT) is defined as the time interval from the time of submission of a process to the time of the completion of the same process. It is the total amount of time spent by a process in the system, and this process can either be a waiting time or the time being in the execution of the task (Amrita, 2021).

There is no perfect nor specific definition of TAT, as to which period should be included in determining TAT for a specific test. For laboratory personnel, it would be from the time of receipt of sample in laboratory till report is generated. (Khalifa and Khalid, 2014). However, for a clinician, it would appropriately be defined as, from the time of his/her requisition of a test till the report reaches him/her. The TAT would not be similar for routine tests versus in STAT/urgent tests. TAT would be different for ICU/emergency services. The causes of poor satisfaction level from lab users includes stat and routine test TAT and stat test TAT is considered by majority as the most important indicator of laboratories functioning (Mebrat *et al.,* 2020). Hospital computerization with record of time from test request, sample collection, report

generation and receipt of report by clinician would help in generating TAT. Analyzing outliers in TAT in a laboratory gives insight to causes delay in TAT and the areas that need improvement. Laboratories in developing countries are yet to use TAT and explore them for laboratory improvement (Mebrat *et al.,* 2020).

Therefore, laboratory turnaround time (TAT)/waiting time (WT), is the time interval between the receipt of specimens in the laboratory to the time of dispatched of reports with verification. Approximately 80% of clinical laboratories or hospital-based laboratories receive complaints about delayed TAT. Prompt receipt of laboratory reports is a pointer of quality services along with accurate, precise and reliable reports, thus each clinical laboratory should recognize all the issues affecting the TAT and endeavor to eradicate them for quality services improvement (Rajendra *et al.,* 2019). Factors encountered during the whole process, from the receipt of samples to releasing the reports, might be responsible for prolonged TAT (Plebani, 2006).

It is estimated 60 to 70 percent of all decisions regarding a patient's diagnosis, treatment, hospital admission, and discharge are usually based on the results of the tests that Medical Laboratory Scientists perform. Therefore, it is imperative for most laboratory services to generally focus more on providing a prompt, dependable report at a reasonable cost, while the clinician gives more stress on how soon (TAT) a report would be available to them. However, most laboratories put unnecessary pressure on only reliability (Antal-Szalmas *et al.,* 2017).

In the world today, many expect everything to be available on time for them to be at ease thereby have everything at their desk. In a similar manner, when any patient enters any healthcare facility to seek treatment, he/she also expects the same. The stability of the process needs to remain continuous so that the patient is able to decide upon anything which is required for further course of action. This is where the TAT plays a major role (Amrita, 2021).

During waiting time, patients commonly involved in three most common events: watching of activities, reading and chatting with their phones. However, engaging patients in health education with recent or specific diseases is a most preferred activity during the waiting period, which is to be presented as health talk by health personnel. The provision of health education on specific health issues constitutes an acceptable and useful way of utilizing waiting time in the outpatient clinic. This may further improve the health education services provided in most hospitals (Ajayi, 2002).

In patient management, laboratory findings and quality of the test report are very important. But another aspect of quality control which is frequently ignored is *timeliness* which is expressed as turnaround time (TAT). In clinical laboratories, TAT is to evaluate laboratory performance and issues associated with patient's delayed in achieving prompt results (Mebrat *et al.,* 2020).

Quality is the capability of a products or services to justify the requirements and confidences of the customer (patients/clinicians). Since laboratories concentrates more on technical and analytical quality for reliability and accuracy of test results. Patients and clinicians however are interested in rapid, reliable and efficient service from the laboratory. Turnaround time (TAT) is the timeliness with which laboratory staffs must deliver test results, and this is one of the greatest obvious symbols of laboratory service and is frequently used as a fundamental indicator of laboratory performance (Kiran *et al.,* 2014). Healthcare quality indicators are often focused on patient centered as a quality performance indicator (Jayasinha, 2016).

Defining Turnaround Time from Different Perceptions

TAT can be defined as "Era for putting a ***process-cycle*****,** into practice, frequently expressed as an *average* of preceding such periods" (Howanitz and Howanitz 2001). The term is usually adopted in shipping and airline industry implying the time the ship or plane is ready for the return journey. In transportation setting, waiting time interval is the time a passenger arrived at the park till the commencement of the journey by the driver (Hara and Gurmeet 2014).

Medical Record's View

It can also be considered as the sum of the time periods spent waiting to get into memory or ready queue, execution on CPU and executing input/output. For instance, patient details are being entered into the system for registration and he is waiting, so the time starting from when the registration is generated to consulting a doctor would explain the TAT. It is a complete cycle of the process. Turnaround time is an important metric in evaluating the scheduling algorithms of an operating system (Amrita 2021).

Clinician's Perspectives

Clinicians defined turnaround time (TAT) as the total time interval for a clinical procedure is carried out and they give more stress on how soon (TAT) a report would be available to them for clinical decisions to be taken. Lundberg described TAT as '*Brain to Brain TAT*' or "*total testing cycle*" and divided the whole process into nine minor units, each independent ones, having influence on TAT. These steps include ordering, collection, identification, transportation, separation, analysis, reporting, interpretation, and action (Lundberg 1981; Zawawi and Justinia 2017). Clinicians desire a rapid, reliable and efficient service delivered at low cost. But others have also used the term "*therapeutic TAT*" to describe the interval between the time a test is ordered to the time when treatment decision are made based on the availability of results generated from the laboratories. Different types of TAT have been adapted from Hawkins. Nevertheless, 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 (Hawkins, 2007).

The entire curative TAT is the stage of ***"from vein to brain",*** that is, the interval between the test request and the healing resolution, while the laboratory TAT starts when the sample come to the laboratory and terminates when the report is released after the results has been validated. However, several laboratories restrict their description of TAT to intra-laboratory because of restrictions in control of extra laboratory causes (Hawkins, 2007).

Medical Laboratory View

In Medical Laboratory setting it can be said to be the time taken to complete a particular laboratory test. Diversity of approaches has been adopted to define TAT. It can be defined based on the investigation performed (e.g. Full Blood Count, Haemoglobin, Potassium), type of patient attended to (e.g. Emergency department, Intensive Care Unit, Wards, OPD etc.), degrees of importance (e.g. stat, urgent or routine) and the activities included (e.g. from the time of sample collection or from the time of receipt of sample in laboratory) (Howanitz and Howanitz, 2001; Hara and Gurmeet, 2014).

Medical Laboratory Turnaround Time (TAT) is one of the key quality indicators to assess laboratory performance, and can differently be defined in accordance with the type of test (stat versus routine), analytic, and institution. It is usually defined as the time from when a test is requested until the result is accurately reported (Mebrat *et al.,* 2020). On other words, many laboratories define TAT as the interim between ***"the time of sample collection and the laboratory report availability to the clinicians",*** which is commonly known as diagnostic turnaround time (Rudest *et al.,* 1995; Khalifa and Khalid, 2014). TAT is subdivided into pre-analysis, analysis and post-analysis. In the ***"total testing cycle",*** TAT is described as grouping of different steps including barcode printing, sample collection, transportation, preparation, analysis, verification and reporting. Laboratory often gives importance on accuracy and precision of the tests as their goals for quality service (Khalifa and Khalid, 2014).

TAT starts counting from the moment the test request is received on database, in the Department of Clinical Laboratory alongside with test requisition form (TRF) and were carefully screened for any possible error. When patient's tests analysis is completed, results of individual parameters are entered in the database either manually or electronically. TAT can be calculated as a ***"time period between receipt of the sample to the time the analysis is completed."*** Once test analysis has been completed, it will immediately be verified (Rajendra *et al.,* 2019).

The performance of laboratories can be objectively assessed using the overall turn-around time (TAT). However, TAT is defined differently by the laboratory and clinicians; therefore, it is important to determine the contribution of all the different components making up the laboratory test cycle (Carraro and Plebani, 20202). Clinical laboratory reports are used to established medical assessments. So, accuracy and timeliness are very crucial factors in clinical laboratory investigations. Both clinicians and patients are usually unhappy for unnecessary elongated waiting time of their laboratory reports. So, it is essential for each laboratory to have its own turnaround time (TAT) (Carraro and Plebani, 2002; Antal-Szalmas *et al.,* 2007).

According to World Health Organization (WHO), (2015) recommendation, it is essential for each laboratory to have its own turnaround time (TAT) based on the investigations required by patients (Bilwani *et al.,* 2003; Froom and Barak, 2015). In the field of clinical laboratory science, accuracy, reproducibility, reliability and promptness has their role to play (Bilwani *et al.,* 2003; Desai *et al.,* 2013). Though, clinical laboratories stresses on accuracy, precision and reliability of the test reports and pay less attention to the prompt release of laboratory reports. Early diagnosis and proper treatment are outcome of calculated accuracy and well-timed work execution. Speedy laboratory test reports can also be a vital factor for the patients to down their expenses by restricting the time of their hospital stay (Holland *et al.,* 2005; Angeletti *et al.,* 2015).

Activities in Medical Laboratory and quality of laboratory test results plays a significant role on medical diagnosis, decision and monitoring prognosis of disease with or without management. In laboratory practice, low performance in relations to test for TAT has a major influence on patient care, delayed test report, and TAT outliers, would have a major impact on the efficiency of diagnosis and management of patients (Holland *et al.,* 2006). Evidence have shown that about 80% of medical decisions are usually based on laboratory investigation outcomes (Plebani *et al.,* 2014). Therefore, prompt delivering of laboratory results is the fundamental strengths of a competent clinical laboratory, whose aim is to deliver an improved-value service to its patients. This feature can be monitored very efficiently by instituting a test parameter, TAT (Zawawi and Justinia, 2007).

Laboratory inaccuracies depends greatly on the steps of the total testing process (TTP). Specifically, laboratory professionals should scrutinize and consider the pre-analytical and post-analytical segments, which have been demonstrated to be more vulnerable to errors than the analytical phase (Mebrat *et al.,* 2020). And previous studies have shown that about 70% of all diagnostic errors occur during the pre-analytical phase. These is because these errors are usually committed by non-laboratory professionals (Plebani, 2017). Operationally, TAT can be defined as the interval between "the time of sample collection" and “the report dispatch to the physicians" (Chandrasekhar, 2018).

In the laboratory, TAT is often defined starting from the time the sample is received to the time the results are dispatched. They argue, and it may be valid at times, that things such as time between ordering a test and sample collection, time between sample collection and transport to the laboratory is not in their hands and so beyond their control. Likewise, the delay in physician analyzing the report and acting on it is also beyond their scope (Hara and Gurmeet, 2014).

These differences in definition of TAT between the clinicians and laboratory was also figured out in 1998 College of American Pathologists (CAP) Q-probe programme where 41.1% laboratories defined TAT as time of receipt in the laboratory to time of report (internal processing time), and 27.0% defined it as ordering of tests to result reporting. While 40% of the physicians defined TAT as starting at the time of physicians request and only 9 % as from the time of sample reaching the laboratory. But the end point of both physician and laboratory personnel are closer together (Hara and Gurmeet, 2014).

Laboratories may disagree with such a priority, arguing that unless analytical quality can be achieved, none of the other characteristics matter

(Plebani and Wu, 2004). Nevertheless, 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. 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. Emergency department (ED) TATs have not improved over several decades (Robert, 2007).

A College of American Pathologists (CAP) Q-Probes survey of TAT in 1998 showed low satisfaction rates concerning the laboratory's sensitivity to urgent testing needs (39%) and meeting physician need (48%) (Howanitz and Steindel, 1991; Robert, 2007). Laboratory TAT was felt to cause delayed emergency department (ED) treatment more than 50% of the time and increased ED length of stay (LOS) over half the time (61%). With the increasing interest in the extra-laboratory phases of the testing process, more laboratories use TAT as a key performance indicator of their service but meeting their internal objectives is frequently the distresses (Robert, 2007).

There are variations of TAT from laboratory to laboratory based on the justification of different laboratories and the clinicians (Hawkins, 2007; Chauhan *et al.,* 2014). Moreover, TAT can also be characterized based on types of tests and patient's priority (outpatients, inpatients, emergency) (Hawkins, 2007). Entire Testing Procedure (ETP) in clinical laboratory encompasses nine basic steps namely, ordering, collection, identification, transportation, preparation, analysis, reporting, interpretation and action (Rajendra *et al.,* 2019). Some laboratories defined emergency TAT as: the interval between sample arrival and reporting of results, the time from test ordering to result reporting and the interval between sample collection and result reporting (Steindel and Howanitz, 2001).

TAT is one of the causative factors of laboratory efficacy and is a measure of uniformity. Human being by nature, they are impatient, and they need all things to be done speedily including the clinical laboratory reports. Consequently, patients choose the hospitals that promise fast service and do not make them wait for long hours for their test reports and proper diagnosis, treatment and management of their medical problems. These facts thus prove TAT crucial for both, medical as well as money-making interpretation (Bilwani *et al.,* 2003; Angeletti *et al.,* 2015).

The prevalence of laboratory inaccuracies varies significantly on the phases of the total testing process (TTP). Laboratory experts should investigate and give attention to the pre-analytical and post- analytical phases, which have been demonstrated to be more vulnerable to faults than the analytical phase. As studies indicated, the pre-analytical phase has the highest error rates, amounting to about 70% of all inaccuracies in laboratory diagnostics (Plebani *et al.,* 2017). Constitutionally, consultation should be made with the end users based on facility setting, staffing, workload, available equipment, material and supplies, the laboratory shall establish suitable turnaround times for each of its laboratory test to determine whether or not it is meeting the conventional target with consistent assessment of the laboratory quality result with TAT" (UNI EN ISO 15189, 2013).

Complete laboratory testing process is divided into three segments, namely, pre-analytical, analytical and post-analytical, and TAT depends on these three stages. The pre-analytical phase denotes the time period between call of test to the time sample get to the hands of professionals and arranged for analysis. The analytical phase is the period of measurement; this is the interval between the beginning of the measurement (actual testing) and the confirmation of the test results. The post-analytical period indicates the time from result verification or printing to the time when the physician observes the results (Steindel and Jones, 2002; Chung *et al.,* 2009). Among these three phases, pre-analytical and post-analytical phases contribute to nearly 96% of the TAT and these factors differ based on the institutional

arrangements, numbers of automation, know-how and conversant of the employee (Roy and Kapil 2014; Imoh *et al.,* 2016).

Different hospitals have predefined TAT based on specific times for laboratory investigations/tests requested from various units: emergency department, intensive care unit (ICU), wards, outpatient departments (OPD) and indoor departments. Poor laboratory performance in terms of test TAT has a major impact on patient care, delayed test report, and TAT outlier, would have a major impact on the efficiency of diagnosis and management of patients (Holland *et al.,* 2006).

Determination of TAT

Laboratories performance can be accurately assessed using the overall turn-around time (TAT). However, since TAT is differently defined by the laboratory and clinicians; therefore, it is important to regulate the contribution of all the diverse mechanisms making up the laboratory test cycle (Leonard, 2020).

To analyze TAT, it is important to know the parameters to be used by both the patients, the laboratories and the hospital in assessing the laboratory services. Measuring TAT starts with establishing a definition of TAT for the specific institution is vital. The most appropriate TAT is starting from the time a physician orders a test to the time he gets back the reports. The timing should then be recorded at every stage starting from ordering a test, followed by time of phlebotomy, time of receipt of sample in the laboratory, the time of report generated followed by dispatch of report and finally the time it is received by a caregiver. With computerization of the whole hospital in which each test requested must be entered in the system before being done. We will have a true data of time taken at every step (Hara and Gurmeet, 2014).

In standard settings today, modern laboratory can be divided into centralized testing or central laboratories and point-of-care testing (POCT). Centralized laboratory medicine offers high-quality results, as guaranteed using quality management programs and the quality of the staff. POCT is performed by clinical staff, and so such testing has moved back closer to the patient. POCT has the advantage of reducing the turnaround time, which profits the patient. However, the clinical laboratory testing proficiency of clinical staff is limited. Consequently, when deciding which components of laboratory testing must be conducted in central laboratories and which mechanisms as POCT (in relation to quality and timeliness), it will be of medical necessity, medical utility, technological capabilities and costs that will have to be ascertained. If suitable quality can be assured, POCT is preferable, considering its timeliness, when testing vital parameters. It is also preferred when the central laboratory cannot guarantee the provision of results of short turn-around-time (STAT) markers within 60 minutes or (even better) 30 minutes. POCT should not replace centralized medical laboratory testing in general, but it should be used in cases where positive effects on patient care have been clearly demonstrated (Ignolf, 2009; Hawkins 2017; Mebrat *et al.,* 2020).

Early diagnosis and appropriate treatment of the patients is an outcome of the calculated accuracy and well-timed execution of the work. Analysis of the test report in time can also be an important factor for the patients to cut down their expenses by shortening the time of their hospital stay (Holland, 2005; Angeletti *et al.,* 2015).

Factors Affecting Turnaround Time in Clinical Laboratories

Any influencing issues encountered during the whole process, from receiving the samples to releasing the results are accountable for elongated TAT. Every day all the standards matching reports generated from the Clinical Laboratory Department are usually analyzed for current TAT, together with the reasons of prolonged TAT are revealed mentioned on the Test Requisition Form (TRF) to the concerned staff might sometimes be neglected.

To identify the associated causes for not achieving standard TAT in clinical laboratories, both bivariate and multivariable logistic must be considered. Different selected variables should also be analyzed. The bivariate analysis result showed that four variables (daily workload at the pre- and post-analytical stages, interrupted LIS, and type of test

order) are statistically and significantly associated with level of TAT performance.

Accordingly, in clinical laboratory tests, the pre- and post-analytical steps during high workload can lead to poor performances and it is usually observed more frequently occurring in 2 to 3 times than the normal time. These contributes to the occurrence of failed TAT performances. These factors that can cause prolong TAT in clinical laboratories are categorized into:

1. Pre-analytical factors:

a. Billing and Registration

These are factors related to billing and registrations which are the most important factors for delaying laboratory reports. These are issues created by other departments rather than laboratory itself. The time consumed to fix the pre-analytical errors created by other departments before samples are received rather than laboratory itself is another major reason for delay in the receipt of laboratory reports. However, reasons for prolonged TAT may vary from hospital to hospital depending on different factors (Rajendra *et al.,* 2019).

b. Sample Collection

Proper blood collection and timely processing are critical pre-analytical steps required for the integrity of laboratory results. Although the influence of blood collection devices on laboratory tests is often overlooked, correct pre-analytical handling is essential. However, many laboratories do not carefully evaluate the suitability of new devices or monitor laboratory ongoing performance. Blood collection materials and devices can alter chemistry test results, with an emphasis on blood collection tube (BCT) additives. Speedy transport is another pre-analytical factor that would further help in reducing TAT (Chung *et al.,* 2009).

c. Sample Transportation

In addition to the above-mentioned factors, transportation of the sample is also one of the factors affecting total TAT. Transportation time can be varied, which can be from specimen collection center to the laboratory or from other wards. It is not actually affecting laboratory TAT but it may affect the total TAT (Rajendra *et al.,* 2019).

2. Analytical factors

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. There are several constrains from a purely laboratory point of view like laboratory practice of collecting samples and doing test on a single day of a week (to reduce cost, efficient use of time of technicians) without compromising the patient service (Hawkins, 2007; Rajendra *et al.,* 2019; Mebrat *et al.,* 2020).

Workflow Automation Overview

Building an automated process to reduce prolong TAT can be done through "***drag-and-drop.***" Each task is represented by a shape and can be connected to other tasks in the proper sequence (or branch off to another part of the process) to simulate the real-world workflow. The simple act of laying out the entire process immediately makes it transparent to be discussed and evaluated by all stakeholders. (Hawkins, 2007; Rajendra *et al.,* 2019; Mebrat *et al.,* 2020 and Rajendra *et al.,* 2019). Apart from paper, phone calls, emails, spreadsheets, and meetings, the system manages the workflow, and tasks are assigned to the right people and alerts, reminders, and escalations when needed. As tasks are completed, the system initiates the next task, on and on, until the process is complete. However, automation in clinical laboratories is very important since it can immensely decrease TAT. Any problems encountered when carrying out the analysis are regarded as the analytical factors, they include the following:

a. Test Repetition Factors

Repetition of test analysis due to critical value reconfirmation and consultation observed values like: hemolyzed samples; insufficient samples; samples not received and unlabeled samples are the most prominent factor covering around 25% for prolonged TAT (Hawkins, 2007; Rajendra *et al.,* 2019; Mebrat *et al.,* 2020).

b. Specimen-Related Factors

Occasionally, specimen related factors like unstable specimen/test; samples marked as

lipemic; unlabeled, mislabeled and clotted. Repetition of tests is another important feature of lengthy TAT in the Clinical Laboratories where patients don't usually get their reports on predefined time due to sample related factors. Visually detected hemolyzed specimens are completely rejected and eventually resulted in deferred reports. This factor can never be overemphasized. It contributes to delay in patients' report. Furthermore, prolongation of laboratory reports was due to poor inventory can still be a contributing and obvious factor accountable for interruption in patients' reports (Mebrat *et al.,* 2020).

c. Reagent related Factors

Reagent related issues due to out of stock, unavailability, not provided or supplied reagents and expired reagents (Mebrat *et al.,* 2020).

d. Equipment/Machine breakdown factors

Equipment related problems could arise as a result of random breakdown and preventive maintenance schedule. (Mebrat *et al.,* 2020).

e. Result validation

However, reasons for prolonged TAT due to result validations may vary with hospital to hospital depending on different factors (Mebrat *et al.,* 2020). This is another issue which must be considered important in patient's TAT. Result validations are to check the quality of results generated from clinical laboratories which must be accurate, reproducible, authenticity, academic qualification like level of knowledge, individual staff attitudes, level of practices; years of working experience, gender and laboratory workloads (ARAFCS, 2018 and Hawkins, 2007).

3. Post-analytical factors

Reporting in time is a crucial indicator of quality services along with accurate, precise and reliable reports, thus each clinical laboratory should identify affecting factors to eliminate them for the enhancement of quality services. Moreover, prolongation of laboratory reports was due to failure of analyzers either due to irregular maintenance or lack of properly functioning analyzers can still be a contributing and obvious factor responsible for delay in patients' reports. Reporting software interruption due to breakdown of reporting (computer) system (Rajendra *et al.,* 2019).

Workflow Automation Overview

Building an automated process can be done via drag-and-drop. Each task is represented by a shape and can be connected to other tasks in the proper sequence (or branch off to another part of the process) to simulate the real-world workflow. The simple act of laying out the entire process immediately makes it transparent to be discussed and critiqued by all stakeholders.

Now, instead of paper, phone calls, emails, spreadsheets, and meetings, the system manages the workflow, and tasks are assigned to the right people and alerts, reminders, and escalations when needed. As tasks are completed, the system initiates the next task, on and on, until the process is complete (Georgiou *et al.,* 2007).

4. Cash Unit Error

Patients' reports are usually delayed due to problem created in cash unit either due to incomplete payment or due to payment not according to test requested in TRF. More patients are affected due to problem in cash unit and since patients from all the departments had to pay before investigation commences. Most Clinical Laboratories reporting database are designed in such a way that report cannot be generated unless a proper payment is made therefore the cash unit is the most important factor for prolonged TAT in Hospitals (Mebrat *et al.,* 2020).

This factor is as a result of payment for Tests in Cash Unit due to missing payment (incomplete payment); wrong payment (not according to prescribed tests); wrong registration (paid in another patient's account) and excess payment (mostly double payment). Cash unit alone has the highest degree of error in total testing process, and it is the most significant factor for prolonged TAT (Rajendra *et al.,* 2019).

5. Staff Strengths and Workloads

Different challenges are faced during clinical laboratory test performances to achieve targeted TAT. Among the main problems identified are daily workload and staff strength. These two factors goes together because, TAT decreases with high staff strength and low workloads. Possible reasons for this difference are when there's high number of daily patient flow. In

clinical laboratories, if there is high number of clients that come to the laboratory, and the staff strength is low there's possibility of delayed TAT (Hawkins, 2007; Rajendra *et al.,* 2019 Mebrat *et al.,* 2020).

6. Departments/Unit-Based Test Factors

The incidence of long TAT is quite different among samples from ER/ICU and OPD/Indoors. Occurrence of abnormal TAT for samples received from ER/ICU is usually higher, about five-folds than samples received from OPD and other indoor departments.

To examining factors affecting prolonged TAT for individual departments, we must consider the varied types of services they delivered. Such as the nature of service provided in emergency room (ER) and intensive care unit (ICU), where prompt action is needed and of course the laboratory reports must be delivered in time and must have less TAT than other departments like general wards and outpatient's departments (OPD) (Rajendra *et al.,* 2019 and Mebrat *et al.,* 2020).

This is an important factor, the unit where the patient is admitted or kept as this determines the patients' medical condition. Tests requested from different units like wards, OPD, emergency, ICU and indoor departments has their specific TAT. Previous studies have showed that tests requested from OPD, and indoor departments are nearly four times less prolonged TAT in comparison to emergency and ICU, and the ratio of samples showing TAT prolongation stood at about 6.98%. (Rajendra *et al.,* 2019).

a. Factors affecting TAT in ER and ICU patients.

The leading cause of laboratory TAT prolongation in ER and ICU patients is the repetition of test analysis 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. Payment related issues were found to be the second most significant factor (32%) for long TAT for tests ordered from ER and ICU. About 17% of sample related issues like hemolysis, low volume, wrong samplings etc. playing role in delaying reports in these units (Mebrat *et al.,* 2020).

b. Factors affecting TAT in case of OPD and indoor patients

In case of the laboratory reports of OPD and indoor patients, the TAT prolongation is mainly billing in cash unit and registration related (Mebrat *et al*., 2020).

7. Staff Knowledge, Attitude and Practices (KAP):

When the staff had different levels of qualifications, knowledge and skills under laboratory profession, the services rendered and delivered in the facility will be different as these factors will decrease laboratory TAT. These factors can be explain further based on the level of knowledge, attitude, practices and some individual staff characteristics of laboratory department (Hawkins, 2007).

Assessing the level of knowledge, attitude, practices, qualifications, work experience, gender and some other characteristics among staff of laboratory department. Level of good practices are virtually similar based on different levels of qualification. The level of knowledge on TAT relatively decreased from higher levels of education to lower levels. Distribution of good knowledge and good practice can increase in accordance with increasing work experience. There will be a drastic decrease in patient's TAT in staff with good attitude and increased number of years of experienced (Mebrat *et al.,* 2020).

Necessities of Laboratory Turnaround Time (TAT)

- TAT is an important feature to describe the efficiency of a Laboratory's Operational System (Kiran *et al.,* 2014).
- It helps the laboratory management to focus more on the patient satisfaction ratio (Jayasinha, 2016).
- TAT is to evaluate laboratory performance and issues associated with patient's delayed in achieving prompt results (Mebrat *et al.,* 2020).
- To embraces huge benefits on departmental efficiency and productivity in conjunction with evaluating individual's played role (Amarita, 2021).
- To increase the effective-ness of the working environment and laboratories (Hara and Gurmeet, 2014).

- To strengthen the relationship between the laboratory workers, the patients and the management (Howanitz *et al.,* 1993).

Methods of Achieving Good Turnaround Time (TAT)

I. **Acclimatize to automation process:** Adapting to an automated process allows one to achieve the goal a step further to which we aim for. It allows the department to function in a precise and productive manner (Georgiou *et al.,* 2007).
II. **Tracking of End-to-End process:** This will allow one to focus more on the bottlenecks and getting them fixed.
III. **Drafting a more defined process:** Defined process allows one to keep a tap of effective utilization of the available resources.
IV. **Multitask trained recruitment:** Staffing of multitasking trained personnel followed by incessant training helps in the majority of time-saving and cost-saving (Amarita, 2021).

Problems of Prolong Turnaround Time (TAT)

The problems posed by lengthen laboratory TAT may lead to patients' prolonged stay in hospital are unhappiness (Robert, 2007), dissatisfaction, eventually affecting hospital service and consequently leading to low or reduced patronage (Rajendra *et al.,* 2019).

Important of Turnaround Time (TAT)

TAT usually helps to ascertain elements associated with faster performance and offer conceivable submissions for service enhancement in clinical laboratories. Therefore, TAT is a very important aspect that explains the efficiency of a Hospital's Functioning System. It helps the management to focus more on the measurement of patient's satisfaction. It holds enormous benefits on departmental efficiency and productivity along with evaluation of individual's role play (Amrita, 2021). Reviewing TAT helps in reducing long delivery time and increases customer satisfaction ratio. It is worthy to note always that deliverables of the desired result are important, but timing is equally essential too, especially in healthcare. Improving on TAT indeed enhance the Customer happiness and Income Sequence relationships (Rajendra *et al.,* 2019).

Conclusion

TAT helps to identify factors associated with faster performance and provide possible suggestions for service improvement in clinical laboratories. There are several constrains from a purely laboratory point of view like lab practice of collecting samples and doing test on a single day per week (to reduce cost, efficient use of time and personnel) without compromising the patient service. The hospital needs to develop their own TAT/more than one TAT in consultation with both the laboratory personnel and the clinicians (the users) for using TAT as a quality constraint for the laboratory services. Computerization and speedy transport of samples would further help in reducing TAT.

Recommendation

1. Each laboratory should look for more and new opportunities for improving and monitoring the inconsistency in patient's TAT.
2. More laboratories should include TAT as a key performance indicator of their service having fulfil their internal objectives.
3. The management should recruit more laboratory staff, give prospects for multitask training, followed by continuous training (retraining) helps in the majority of time-saving and cost-saving processes.
4. Finally, Medical Laboratory Scientists must align their professional practices with a cultural service and should be aware that services and cares rendered are all about patient's satisfaction which is to improve patient flow, to safeguard the patient's "***check-in and checkout"*** without hindrance.

References

Ajayi, I.O, (2002). Patients' waiting time at an outpatient clinic in Nigeria--can it be put to better use? *Patient Education and Counseling*; **47(2)**:121-126.

Alain, C., Rostin, M., Joël, K., Hypolite, M., Donatien, K., Koffi, T., Jérémie, M. and Hippolyte, S. (2021) "Evaluation of Clinical Laboratory Tests' Turnaround Time in a Tertiary Hospital in Democratic Republic of the Congo." *Journal of Biosciences and Medicines;* **09(07)**:96–111. doi: https://doi.org/10.4236/jbm.2021.97011.

Annual report of Armed Force Comprehensive

Specialized Hospital, 2018 (2010ec) (*Unpublished)*.

Antal-Szalmas, P., Ivady, G., Molnar, A., Hevessy, Z., Kissne Sziraki, V., Olah, A, *et al*. (2007). "Turnaround Time": A New Parameter for the Characterization of the Overall Efficacy of Laboratory Diagnostic Processes. *Orv Hetil.* **148**(28):1317-1327.

Bhattarai, K. and Manandhar, N. (2018). Turnaround Time in Clinical Chemistry Laboratory: A Hospital Based Study on Billing-to reporting and collection to reporting times. *ACTA Scientific Medical SciencesJournal;* **2(3)**: 26-32.

Bilwani F, Siddiqui I, Vaqar S. (2003). Determination of Delay in Turn Around Time (TAT) of Stat Tests and its Causes: An AKUH Experience. *Journal of Pakistan Medical Association;* **53(2)**:65-67.

Cakirca, G. (2018). The Evaluation of Error Types and Turnaround Time of Pre analytical Phase in Biochemistry and Hematology Laboratory. *Iranian Journal of Pathology;* **13(2)**:173.

Carraro, P., and Plebani, M. (2002). Process Control Reduces the Laboratory Turnaround Time. *Clinical Chemistry Laboratory Medicine;***40(4)**:421-422.

Chandrasekhar, G.S. (2018). Total Turnaround Time of Clinical Laboratory: An Assessment tool for Laboratory Performance. *Journal of Dental and Medical Sciences;* **17(9)**:6.

Chung, H.J., Lee, W., Chun S., Park H., and Min, W. (2009). Analysis of Turnaround Time by Subdividing Three Phases for Outpatient Chemistry Specimens. *Annals of Clinical & Laboratory Sciences;* **39 (2)**: 144-149.

Eshetu, L.H. (2018). Evaluation of Hospital Laboratory Workflow Design in Ethiopia: Blood Specimen Collection and Chemistry Laboratory. *Ergonomics International Journal;* **2(9)**:2577-2953.

Eyob, A.M., Binyam, T., Getachew, B., Aytenew, A. and Veronica, G. (2017). Factors affecting quality of laboratory services in public and private health facilities: *Electronic Journal of the International Federation of Clinical Chemistry and Laboratory Medicine;* **28(3)**: 205–223.

Froom, P., and Barak, M. (2015). Auto-Validation of Complete Blood Counts in an Outpatient's Regional Laboratory. *Clinical Chemistry and Laboratory Medicine;* **53(2)**:275-279.

Pati, H.P., Singh, G. (2014). Turnaround Time (TAT): Difference in Concept for Laboratory and Clinician. *Indian Journal of Haematology Blood Transfusion;* 30(2):81-84. doi: 10.1007/s12288-012-0214-3.

Hawkins, R.C. (2007). Laboratory Turnaround Time. *Clinical Biochemist* **28(4)**:179-194.

Holland, L.L., Smith, L.L. and Blick, K.E. (2006). Total laboratory automation can help eliminate the laboratory as a factor in emergency department length of stay. *American Journal of Clinical Pathology;* **125**: 765.

Howanitz, P.J., Cembrowski, G.S., Steindel, S.J., Long, T.A. (1993). Physician goals and laboratory test turnaround times. A College of American Pathologists Q-Probes study of 2763 clinicians and 722 institutions. *Archives of Pathology and Laboratory Medicine*; **117**:22–28.

Ialongo, C., Bernardini, S. (2016). Timeliness "at a glance": assessing the turnaround time through the six-sigma metrics. *Biochemiamedica;***26** (1):98.

Imoh, L.C., Mutale M., Parker, C.T., Erasmus, R.T., and Zemlin, A.E. (2016). Laboratory-based clinical audit as a tool for continual improvement: an example from CSF chemistry turnaround time audit in a South-African teaching hospital. *Biochemistry Medicine;* **26**(2):194-201.

Ingolf Schimke. (2009). Quality and timeliness in medical laboratory testing. *Analytical and Bioanalytical Chemistry;* 393:1499-1504.

Jayasinha, Yasangi. (2016). Decreasing Turnaround Time and Increasing Patient Satisfaction in a Safety Net Hospital–Based Pediatrics Clinic Using Lean Six Sigma Methodologies. *Quality Management in Health Care*; **25(1)**:38-43. doi:10.1097/QMH.0000000000000083.

Khalifa, M, Khalid, P. (2014). Improving Laboratory Results Turnaround Time by Reducing Pre-Analytical Phase. *Integrating Study on Health Technology and Information;* **202**:71-74.

Kiran, P. Chauhan, Amit, P. Trivedi, Dharmik, Patel, Bhakti Gami and Haridas, N. (2014).

Monitoring and Root Cause Analysis of Clinical Biochemistry Turn Around Time at an Academic Hospital. *Indian Journal of Clinical Chemistry;* 29:505–509.

Leonard Mutema, Zivanai Champanduka, Fungai Musaigwa, and Nomusa Mashigo (2014). In-depth investigation of turn-around time of full blood count tests requested from a clinical haematology outpatient department in Cape Town, South Africa. *Indian Journal of Clinical Biochemistry*. 29:505-509. doi: 10.4102/ajlm.v10i1.1318.

Lou, A.H., Elnenaei, M.O., Sadek, I, Thompson, S, Crocker, B.D and Nassar, B. (2016). Evaluation of the impact of a total automation system in a large core laboratory on turnaround time, *Clinical Biochemistry;* **49 (16-17)**: 1254-1258.

Manor, P.G. (1999). Turnaround times in the laboratory: A Review of the Literature. *Clinical Laboratory Science;* **12(2)**:85-89.

Mebrat Gebreyes, Abay Sisay, Dilargachew Tegen, Abushet Asnake and Mistire Wolde (2020). Evaluation of Laboratory Performance, Associated Factors and Staff Awareness Towards Achieving Turnaround Time at Armed Force Comprehensive Specialized Hospital, Addis Ababa, Ethiopia. *Ethiopian Journal of Health Science;* **30**(5):767. DOI: http://dx.doi.org/10.4314/ejhs.v30i5.17.

Mohammad, J., Keivan S., Ali, M., Mohammad, M., Maziar, M.L. (2012). Identifying Causes of Laboratory TAT Delay in the Emergency Department. *Archives of Iran Medicine*; **15(12)**:759.

Plebani M. (2006). Errors in clinical laboratories or errors in laboratory medicine? *Clinical Chemistry and Laboratory Medicine*; **44(6)**:750-759.

Plebani, M, Sciacovelli, L. and Aita, A. (2017). Quality indicators for the total testing process. *Clinics in Laboratory Medicine;* **37(1)**:187-205.

Plebani, M., Sciacovelli, L., Aita, A. and Chiozza, M.L. (2014). Harmonization of pre-analytical quality Indicators. *Biochemial Medica;* **24(1)**:105–113. http://dx.doi.org/10.11613/BM.2014.012.

Rajendra Dev Bhatt, Chandani Shrestha and Prabodh Risal (2019). Factors Affecting Turnaround Time in the Clinical Laboratory of the Kathmandu University Hospital, Nepal. *The electronic Journal of the International Federation of Clinical Chemistry and Laboratory Medicine;* 30(1):14-24.

Roy, A.D. and Kapil, J. (2014). An Evaluation of Turn Around Times (TAT) in The Clinical Pathology Laboratory of a Referral Hospital and Root Cause Analysis of Delay in Dispatch of Reports. *International Journal of Scientific Research;* **3(8)**: 22277-8179.

Steindel, S.J., and Jones, B.A. (2002). Routine outpatient laboratory test turnaround times and practice patterns. *Archives of Pathology and Laboratory Medicine;* **126**(1):11-18.

UNI EN ISO 15189. (2013). Medical laboratory: requirements for quality and competence. Geneva (Switzerland): International Organization for Standardization.

Wankar, A.D. (2014). Study of determination of laboratory turnaround time in tertiary care hospital in 18. *India International Journal of Research in Medical Sciences;* **2(4)**:1396.

World Health Organization, (2015). WHO recommendation for Laboratory Turnaround Time.

World Health Organization, (2015). WHO Laboratory Quality Stepwise Implementation Tool. https://extranet.who. int/lqsi/content/determine-turnaround-time-each-examination-performed-laboratory

Zawawi, R. and Justinia, T. (2017). Laboratory Information Systems and Analytical Turnaround Time. *IMedPub Journals*; **4(5)**:1-12.

Citation: Ige Ilesanmi Paul, Mokwenye Victoria, Obadire Samuel Olalere. Patient Turnaround Time: Concern of Medical Laboratory Scientist. ***Sokoto Journal of Medical Laboratory Science*; 8(1):96-107**. https://dx.doi.org/10.4314/sokjmls.v8i1.12.