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Research Article

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Convalescence of Recuperated Turnaround Time "TAT" in Metabolic Profile Using Artificial Intelligence Permeated Integrated Total Lab Automation System

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Abstract: TAT are usually sample sent from ward till report out from lab, sample received on dispatching lab counter till reporting from respective lab or sample received in respective clinical labs section and reports availability. Aim: Tendency analysis of TAT for our metabolic profile tests of last two years (June 2022-May 2024), was assessed in this report. Materials and Methods: In this report Turnaround Time (TAT) for requested metabolic parameters such as urea, creatinine, electrolytes, total protein, cholesterol, liver function tests, calcium, magnesium, insulin and phosphorous were assessed for trend and tendency of improvement in receive to report timings. Date collected and analyzed from June 2022 to June 2024 and noted to manifest efficiency in TAT. Furthermore, integrated system and Artificial intelligence permeated analytical units enhanced efficiency to facilitate Intensive care units, emergency wards has been accelerated, by providing results within 45 minutes and then gradually go down to within 20 minutes over a period of 2 years. We procured Roche Cobas total lab automation system with pre-analytical p471, analytical i.e. immunoassay e801, and chemistry c503 and post analytical p501. Results: We have seen enhancement of TAT efficiency from 45 min in 2022 to 18-25 minutes in 2024. Because of strategic procurements of TLA analyzers with AI assistance we were able to achieve our planned targets of recuperated TAT. For near future, technical staff will be further trained to use more advanced options of TLA to get accelerated reports to patients, end users and clinicians. Conclusion: Around 20% to 25% enhancement was noted in TAT of our metabolic profile during last 2 years. Recuperated TAT and quality assured analysis of samples and availability of results facilitates not only shortening of patients' stay at hospital, but timely reporting helps quick, efficient, accurate clinical decision.

Keywords: TAT, Total lab automation, liver function tests, pre analytical, analytical and post-analytical.

Introduction

Early reporting by clinical laboratories always facilitate clinician, intensivist, surgeons to take prompt, accurate and efficient decisions which saves life of the patient and most of the time shortens hospital stay, which saves patients

from infections and financial burdens. Efficient and recuperated Turnaround time or TAT is a terminology used to define reporting of a sample sent to clinical laboratory for analysis and need at a specified time. TAT has several definitions depending upon institute, requirements and system and be any one of a) sample sent from ward till report out from lab, b) sample received on dispatching lab counter till reporting from respective lab or c) sample received in respective clinical labs section and reports availability [1]. In our institute accepted definition is basically the last one, which is time of receiving of samples within the respective specialty of lab till results availability either hardcopy or online as per designated TAT. Significance of specified TAT is essentially the dependence of clinical decisions on lab results, thus every lab should have a TAT with preferred accuracy and precision [1-6]. Moreover, early diagnosis and treatment of patients, through availability of timely, well precise and quality assured lab reports is becoming one of the key performance index (KPI) of any medical service [1,2,7-8]. Furthermore, better TAT and accurate analysis of samples and availability of results also helps in shortening of patients' stay at hospital, thus cutting their expenses and exposure to nosocomial infections [9]. Recuperated TAT necessarily facilitate emergency department as well as intensive care units (ICUs) where pre-analytical errors, overcrowding, longer stay, delay in treatments and admission, because of delayed lab results, can cause overburden, avoidable medical errors, drastic untoward clinical consequence and outcome [6-9]. Present study described convalescence of recuperated TAT for metabolic profile tests last two years 2022-2024.

Materials and Methods

Metabolic chemistry profile for our department of clinical biochemistry lab services and chemical pathology includes urea, creatinine, electrolytes, Liver function tests, calcium, magnesium, phosphorous and insulin. Since the inception of TLA, we decided to accelerate our analytical efficiency to facilitate emergency department and ICUs, by providing urea, creatinine, electrolytes, Liver function tests, calcium, magnesium, phosphorus and sometimes insulin with 45 minutes and then gradually go down to within 18-20 minutes over a period of 2 years. Due to availability of AI facilitated additional reinforcement of analyzers, we dedicated analyzers to conduct analyses of metabolic profile and report within 45 min 2022, within 30-35 minutes in 2023 and within 18-25 minutes in 2024. Total lab automation system with pre-analytical p471, analytical i.e. immunoassay e801, and chemistry c503 and post analytical p501. Liaquat National Hospital Clinical Laboratories, especially Clinical Biochemistry department has been established in 1974 and since then pioneer in harnessing and promoting technical advancement. Ours is a750 bedded tertiary care hospital with 34 specialty under one roof. We receive around 1400 samples, amounting to 560-700 patients on daily basis. TAT in our laboratory is defined as samples received within our department-lab till results availability either hardcopy or online as per designated time line. Earlier performed study by the same department was taken as bench mark and similar method was used to perform current study [1].

Results

Results are summarized in Figure 1 to 2, i.e. June 2022 to May 2023, and June 2023 to May 2024. In both years' time period, few peaks and valley pattern was noted with less than 3 minutes of variations. Most commonly requested metabolic profile parameters are always been urea, creatinine, electrolytes, hepatic enzymes, albumin, ions such as calcium, magnesium and phosphorus. Data exhibited Urea, creatinine, electrolytes, Liver function tests, calcium, magnesium, phosphorus and sometimes insulin TAT within 45 minutes and then gradually go down to within 18-20 minutes over a period of 2 years. Due to availability of AI facilitated additional reinforcement of analyzers, we dedicated analyzers to conduct analyses of metabolic profile and report within 45 min 2022, within 30-35 minutes in 2023 and within 18-25 minutes in 2024. As we prospered, we procured Total lab automation system with pre-analytical p471, analytical i.e. immunoassay e801, and chemistry c503 and post analytical p501. Liaquat National Hospital Clinical Laboratories, especially Clinical Biochemistry department has been established in 1974 and since then pioneered harnessing and promotion of technical advancement in lab services. Several pre-analytical errors were noted, such as hemolysed samples, low quantity of samples, incomplete bar codes, which however didn't affect our performance and dedicated TAT time line.

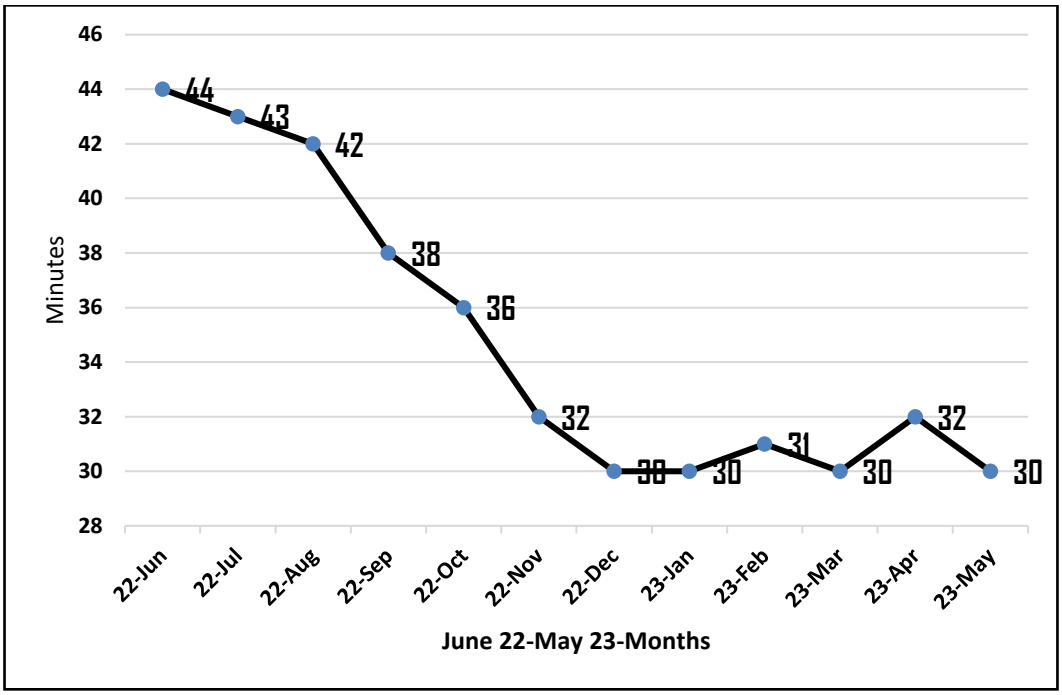

Figure 1A: Assessment of trend analysis regarding TAT for metabolic profile of Urea, Creatinine and Electrolytes during June 22-May 23

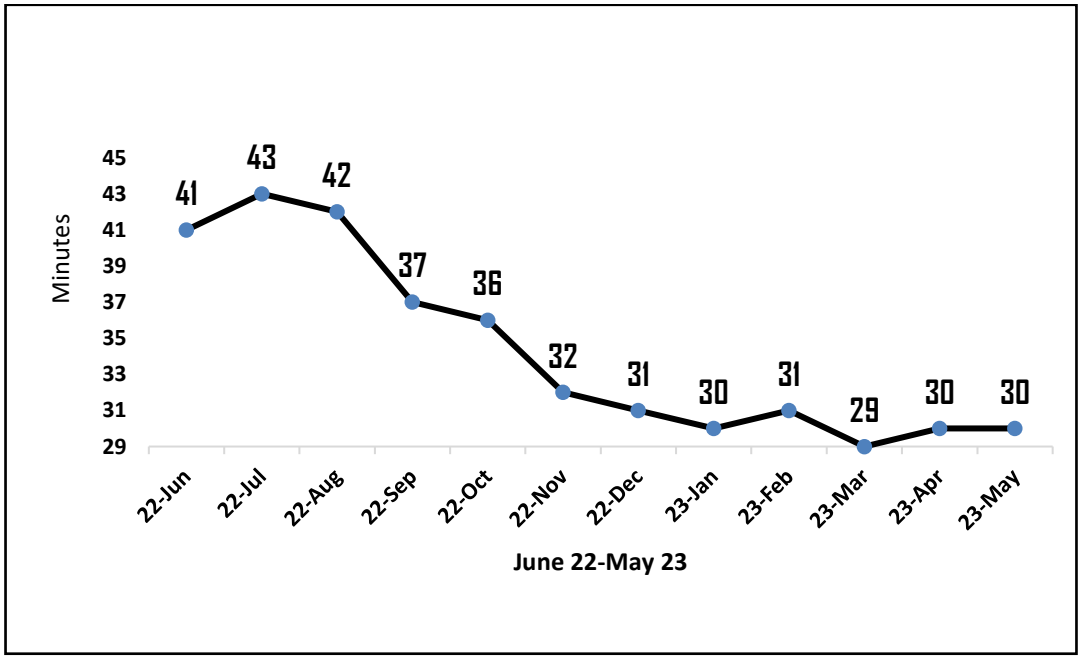

Figure 1B: Assessment of Trend analysis regarding TAT for metabolic profile of Liver Function Tests, Ions, Insulin during June 22-May 23

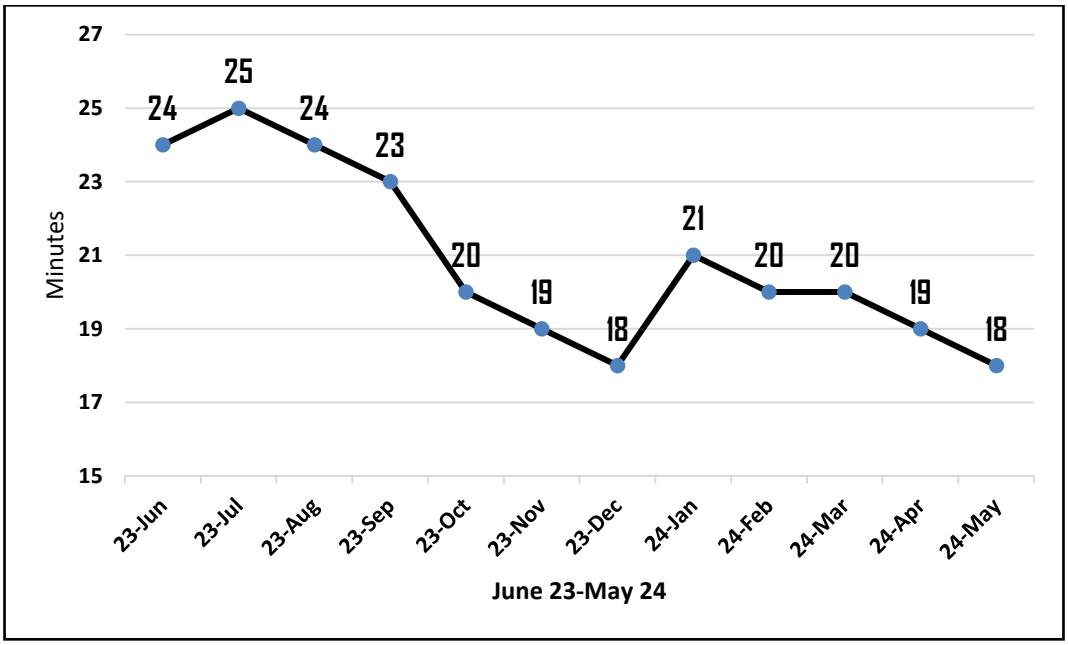

Figure 2A: Assessment of Trend analysis regarding metabolic profile of urea, creatinine, electrolytes during June 23-May 24

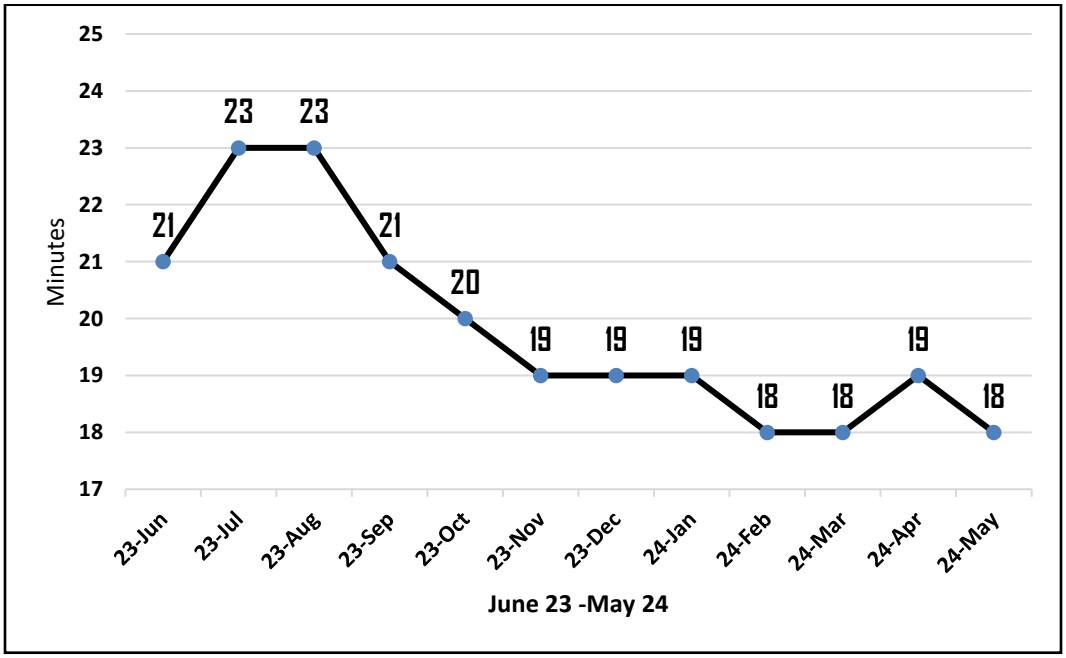

Figure 2B: Assessment of trend analysis regarding metabolic profile of liver function tests, ions, Insulin during June 23-May 24

Discussion

Delayed reports, results in delayed clinical decision, causing unnecessary hindered treatment decisions and financial burden on patients [1, 3, 11-13]. Quality assured services also include designated TAT, mostly in tertiary care laboratories [5, 16]. However, even after having most advanced AI assisted recuperated TLA systems, challenges erupt, mostly when pre-analytical phase was properly controlled, resulted in deviation regarding quality and quality of blood samples. One cannot control systemic error, if gets embedded in pre-analytical phase, causing either

individual sample or whole batch to be compromised [17]. Nonetheless advanced labs and all clinical labs in general, made great efforts to meet designated TAT, although it always been an uphill task due to various factors, inclusive of untrained staff, staff shortage, unavailability of ample number analyzers, pre-analytical delays etc [5, 6-9]. In current study, due to availability of AI facilitated additional reinforcement of analyzers, we dedicated analyzers to conduct analyses of metabolic profile and report within 45 min 2022, within 30-35 minutes in 2023 and within 18-25 minutes in 2024. In an earlier published study, around 36% stat reports exceed their designated TAT, while 7% of routine chemistry reports were out of defined TAT [3-5]. Moreover, reason behind these delays (which cumulatively became 75%) were various extra analytical steps taken such as reruns, QA procedures etc, whereas 48% was due to financial/cash. In a study published recently detailed that a total of 18282 indoor patient samples were assessed for TAT, out of which ABGs (n=3407, 99.5%), Trop-I (n=755, 85.40%), S/E (n=6497, 72.39%), CBC (n=16117, 88.15%), amylase (n=326, 86.47%), RFTS (n=7541, 78.07%) were reported within the defined TAT. However, there were delays in reporting within defined TAT (2), due to hemolysed and clotted samples (14.22%), specimen dilution and re-run for the verification of result (12.96%), and incorrect patient registration (12.64%). An earlier study published by this department reported allocated TAT within one hour for years 2015-2016, within 50 to 45 minutes 2017-2018 and within 30 minutes 2019 [1]. Because of strategic procurements of analyzers Cobas c501 (Roche, Basil) for routine chemistries, Nova 8 CRT (Nova biomedical, USA) for electrolytes and Cobas e411 (Roche, Basil) for Troponin I, they reported to be progressed to 2018 and beyond and was able to achieve planned targets of effective TAT. As they prospered, the department also procured additional instruments which made our tasks and plans achievable upto less than 30 minutes reporting time in year starting 2019 [1].

Conclusion

Current study concluded that around 20% to 25% enhancement was noted in TAT of our metabolic profile during last 2 years. Recuperated TAT and quality assured analysis of samples and availability of results facilitates not only shortening of patients' stay at hospital, but timely reporting helps quick, efficient, accurate clinical decision.

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