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Effect of the Pandemic on the Turnaround Time Intervals in the Public Health Laboratory

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ABSTRACT

Introduction: Turnaround time is one of the most important signs of a laboratory service which many clinicians use to evaluate the quality of the laboratory. Pandemic has enlightened the importance of laboratory medicine in healthcare organizations. Each step in total testing process can be affected by errors essential in laboratory medicine. Our study aims to evaluate the impact of the COVID-19 pandemic on turnaround time.

Material and Methods: We evaluated turnaround time periods of the routine biochemistry, immunoassay, hematology, hemoglobinopathies, HbA1c and blood-typing. In our study, intra-laboratory turnaround time, which is starting from sample acceptance time to results' verification time is determined. Defined turnaround time duration for all type of analytes are 1440 min. Time intervals in study as listed; Group 1 (pre-pandemic stage), Group 2 (pandemic stage), and Group 3 (post-pandemic stage). Frequency of samples with a TAT exceeded the laboratory's cutoff time interval was determined and compared within groups.

Results: The percentage of exceeded turnaround time of all analytes, except blood typing, hematology and HbA1c in the Group 1 are significantly lower than other groups. With regards to comparing Group 2 and Group 3, percentage of exceeded turnaround times of HbA1c and hematology samples in the Group 3 are found significantly lower than the Group 2

Discussion: Turnaround time can be evaluated as a benchmark of the laboratory performance. Workload of the laboratories should be taken into consideration is specific situations, like pandemic.

Keywords: Laboratory Quality, Turnaround Time, Pandemic

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Halk Sağlığı Laboratuvarında Test İstem Sonuç Süre Aralıklarına Pandeminin Etkisi

ÖZET

Giriş: Test istem sonuç süresi, laboratuvar kalitesini değerlendirme amaçlı, çoğu klinisyenin kullandığı önemli bir parametredir. Pandemi dönemi, sağlık hizmeti organizasyonlarında laboratuvar tıbbının önemini bir kez daha göstermiştir. Toplam test sürecindeki her bir basamak, laboratuvar tıbbında önemli olan hatalardan etkilenebilmektedir. Çalışmamızın amacı test istem sonuç süresine COVID-19 pandemisinin etkisini göstermektir.

Materyal ve Metot: Rutin biyokimya, immünassay, hematoloji, hemoglobinopati değerlendirmesi, HbA1c ve kan gruplama parametrelerindeki test istem sonuç süresi değerlendirilmiştir. Çalışmamızda, örneğin kabul zamanı ile sonuçların onaylanma süresi arasındaki fark olarak da bilinen, laboratuvar içi test istem sonuç süresi kullanılmıştır. Laboratuvarımızda belirlenen test istem sonuç süresi, 1440 dk'dır. Çalışma grubundaki zaman aralıkları; Grup 1 (Pandemi öncesi dönem), Grup 2 (Pandemi dönemi) ve Grup 3 (Pandemi sonrası dönem) olarak gruplandırılmıştır. Laboratuvarın belirlediği test istem sonuç süresini aşan örneklerin sıklığı belirlenmiş ve gruplar arası karşılaştırması yapılmıştır.

Sonuçlar: Grup 1'deki Kan grubu, hematoloji ve HbA1c analizleri dışındaki diğer analizlerdeki test istem sonuç süresini aşan numune sıklıkları, diğer gruplara göre daha düşüktür. Grup 2 ve Grup 3 karşılaştırıldığında, HbA1c ve hematoloji örneklerindeki test istem sonuç süresi aşma sıklığı, Grup 3'de anlamlı düzeyde düşüktür.

Tartışma: Test istem sonuç süresi, laboratuvar performansının bir belirteci olarak değerlendirilebilir. Laboratuvarların iş yükü, pandemi gibi spesifik durumlarda göz önünde bulundurulmalıdır.

Anahtar Kelimeler: Laboratuvar Kalitesi, Test istem sonuç süresi, Pandemi

Clinical laboratories have a classically limited analytical and technical quality discussion, focusing on imprecision and inaccuracy goals (1). At the same time, clinicians evaluate the "quality of the laboratory" for rapid, reliable, and efficient service delivered at a low cost (2). To illustrate this, timeliness is one of the essential features prepared for evaluation as one of the crucial quality steps.

Turnaround time (TAT) is one of the most important signs of a laboratory service which many clinicians use to evaluate the quality of the laboratory (3). The definition of TAT can be varied by test, priority, or population-based. According to Lundberg, who assessed the total-testing cycle, it is necessary to achieve the following steps to perform a laboratory test: ordering, collection, identification, transportation, preparation, analysis, reporting, interpretation, and action (4). Due to the limitations of controlling all the steps mentioned above, most laboratories evaluate TAT through their intra-laboratory activities.

Coronavirus disease (COVID-19) is caused by severe acute respiratory coronavirus type 2 (SARS-CoV-2), firstly reported in China, and World Health Organization (WHO) declared SARS-CoV-2 a pandemic in March 2020 (5). In Turkey, the first case was announced on the 11th of March, 2020, and numerous precautions, including an outdoor mask mandate, school closures, transportation restrictions, contact tracing, and lockdowns (weekdays and weekends). In line with the decisions taken by the Presidential Cabinet Meeting on 21st June 2021, a circular was issued outlining the start of a gradual normalization period, which started as of 1st July 2021 (6).

Pandemic has enlightened the importance of laboratory medicine in healthcare organizations. Each step in the total testing process can be affected by errors essential in laboratory medicine. Our study aims to evaluate the impact of the COVID-19 pandemic on the turnaround time based on pre-pandemic, during a pandemic, and post-pandemic periods.

MATERIAL AND METHODS

Definition of TAT

In our study, we used intra-laboratory TAT, starting from the sample acceptance time to the results verification time.

Study Design

Our study has a retrospective design. In the Mardin Public Health Laboratory, samples ordered from family physicians in Mardin are analyzed. Mardin is a city in the Southeastern Part of Turkey; its population in 2021 was 862757. Samples ordered from the city center of Mardin are performed within the day shift. However, samples collected from the districts of Mardin are performed within the night shift. Our laboratory is closed on the weekends. Our defined TAT duration for all type of analytes are 1440 min (one-day).

We evaluated TAT periods of the routine biochemistry (Abbott Architect c8000, Abbott, Abbott Park, Ilinois, USA), immunoassay (Abbott Architect i2000SR, Abbott, Abbott Park, Ilinois, USA), full-blood count (Sysmex XN1000, Sysmex Corporation, Japan, Sysmex XT1000, Sysmex Corporation, Japan) hemoglobinopathies (Arkray, ADAMS HA-8180V, Minnesota, USA), HbA1c (Abbott Architect c8000, Abbott, Abbott Park, Ilinois, USA), blood-typing (Ortho Vision, France)

The laboratory staff was assigned into three groups: a day shift (08:00-17:00) on workdays (Monday, Tuesday, Wednesday, Thursday, and Friday) who are responsible for routine biochemistry, immunoassays, and HbA1c; a day shift (08:00-17:00) of workdays which are accountable for hemoglobinopathies, blood-typing, hematology and a night shift (17:00-24:00) of workdays which are responsible for all types of analyzers.

The Time interval of the study is divided into three groups: Group 1 (pre-pandemic stage), Group 2 (pandemic stage), and Group 3 (post-pandemic stage) are stated time intervals from March 2018 to January 2019; from July 2020 to May 2021 and from July 2021 to May 2022, respectively.

A number of patients found positive for COVID-19 in Mardin were taken from Mardin Local Health Authority.

The samples were grouped in terms of panel and sample receipt day and time via VENTURA ALIS, the laboratory information system. Results verification times of samples were also retrieved from the system. The time interval between sample acceptance and result verification was considered the TAT.

Samples that were rejected and misidentified specimens were not included in the study. Samples without acceptance time were also excluded.

Statistical Analysis

Statistical analyses were performed MedCalc® Statistical Software version 20.009 (MedCalc Software Ltd, Ostend, Belgium; https://www.medcalc.org; 2021) and GraphPad Prism version 8.0.0 for Windows, GraphPad Software, San Diego, California USA, www.graphpad.com".

After the frequency of samples with a TAT exceeded the laboratory's cutoff time interval was determined, the proportion of these samples to all samples of all groups was compared with a chi-square test. p<0,05 was considered statistically significant.

The study procedure was based on the Helsinki Declaration and confirmed by the local ethics board (2022/147).

RESULTS

Mean TAT of all groups are shown in Figure 1.

The number of total samples and number of samples that exceeded the defined TATs are given in Table 1.

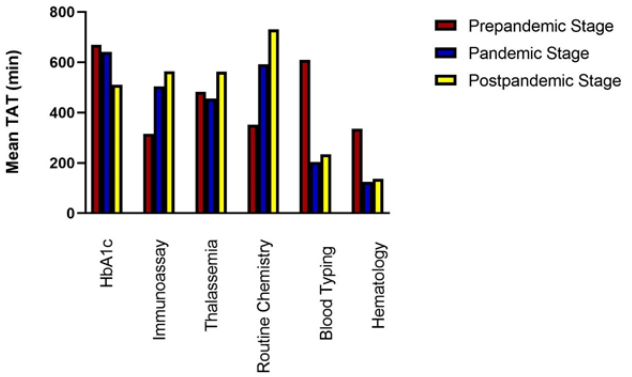

Figure 1. *Mean TAT of All Groups*

Table 1. The Number of Total Samples and Number of Samples that Exceeded the Defined TATs

		Samples that Exceeded TAT	Total Samples	p*
HbA1c	Prepandemic Stage	1017	19810	<0,001
	Pandemic Stage	1812	24085	
	Postpandemic Stage	2535	39520	
Immunoassay	Prepandemic Stage	582	62399	<0,001
	Pandemic Stage	4052	72074	
	Postpandemic Stage	4855	88696	
Thalassemia	Prepandemic Stage	555	14983	<0,001
	Pandemic Stage	1137	15046	
	Postpandemic Stage	1290	16789	
Routine Chemistry	Prepandemic Stage	578	53472	<0,001
	Pandemic Stage	5946	77759	
	Postpandemic Stage	7089	93686	
Blood Typing	Prepandemic Stage	1990	28024	<0,001
	Pandemic Stage	670	31001	
	Postpandemic Stage	877	38038	
Hematology	Prepandemic Stage	1166	61829	<0,001
	Pandemic Stage	1377	78115	
	Postpandemic Stage	1233	95757	

** Evaluated by Chi-Square Test*

According to Table 1,

The percentage of exceeded TAT of HbA1c samples in the pre-pandemic stage are found significantly lower than pandemic and post-pandemic stages (p<0,001).

The percentage of exceeded TAT of immunoassay samples in the pre-pandemic stage are found significantly lower than pandemic and post-pandemic stages (p<0,001).

The percentage of exceeded TAT of thalassemia samples in the pre-pandemic stage are found significantly lower than pandemic and post-pandemic stages (p<0,001).

The percentage of exceeded TAT of routine chemistry samples in the pre-pandemic stage are found significantly lower than pandemic and post-pandemic stages (p<0,001).

The percentage of exceeded TAT of blood typing samples in the pre-pandemic stage are found significantly higher than pandemic and post-pandemic stages (p<0,001).

The percentage of exceeded TAT of hematology samples in the post-pandemic stage are found significantly lower than pandemic and pre-pandemic stages (p<0,001).

The percentage of exceeded TAT of HbA1c samples in the post-pandemic stage are found significantly lower than pandemic stage (p<0,001).

The percentage of exceeded TAT of hematology samples in the post-pandemic stage are found significantly lower than pandemic stage (p<0,001).

There is no difference between the percentage of exceeded TAT of immunoassay samples between pandemic and post-pandemic stage (p:0,19).

There is no difference between the percentage of exceeded TAT of thalassemia samples between pandemic and post-pandemic stage (p:0,67).

There is no difference between the percentage of exceeded TAT of routine chemistry samples between pandemic and post-pandemic stage (p:0,39).

There is no difference between the percentage of exceeded TAT of blood typing samples between pandemic and post-pandemic stage (p:0,20).

Comparisons of the proportion of the samples which are exceeded the TAT among groups are shown in Figure 2.

Comparison of the COVID-19 cases and percentage of samples that exceeded TAT are shown in Figure 3.

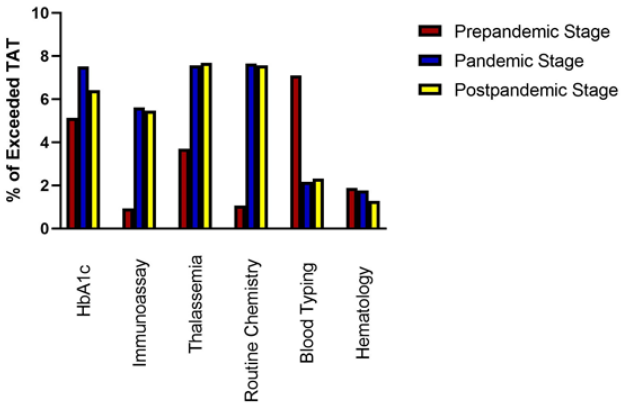

Figure 2. *Comparisons of the Proportion of the Samples which are Exceeded the TAT Among Groups*

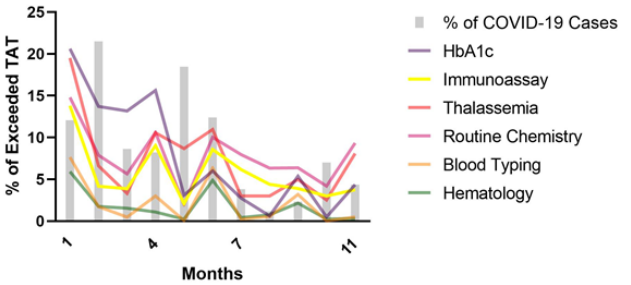

Figure 3. *Comparison of the COVID-19 Cases and Percentage of Samples that Exceeded TAT*

DISCUSSION

TAT still looks as an important parameter for evaluating the quality of the laboratory. Definition of TAT may vary. It can be related with the type of laboratory (emergency, central and/or public health), the population served (7).

In Turkey, samples that ordered from family health medicine clinics are evaluated. As it mentioned, preanalytical stage is the most common problems that affected on prolonged TAT (8). Preanalytical errors are also hard to solve in the public health laboratory for some reasons such as transportation among suburbs, ineffective centrifugation etc.

Our study has two hypotheses. First hypothesis is there was no significant difference in percentage of samples with exceeded-TAT in prepandemic, pandemic and post-pandemic stage.

As it shown in Table 1, percentage of samples with exceeded-TAT in pre-pandemic stage was significantly lower than pandemic and post-pandemic stage. Difference in number of samples may be the possible explanation for this result. There was growing number of samples in pandemic and post-pandemic stage, compared to pre-pandemic stage.

Second hypothesis is there was a significant difference in percentage of samples with exceeded-TAT in pandemic and postpandemic stage.

However, in our study, there were no differences between the percentage of exceeded TAT in pandemic and post-pandemic stage for routine biochemistry, thalassemia, blood typing. As mentioned before, samples from family health clinics are performed in the public health laboratory. Therefore, this may be reason for this result.

In the literature, there are some reports which are evaluated TAT in laboratories. However, these articles are interested in emergency laboratories, especially (9, 10). Because of the differences among the laboratories, it is hard to compare the TAT's of the laboratories.

The COVID-19 pandemic has been affected all parts of the world and also still behave as a threat for both laboratories and health care systems. Because of the high number of COVID-19 cases, laboratory staff's workload had been higher, therefore test process and also TAT is prone to the errors the high workload of the laboratory staff, and the enhanced pressure, the laboratory test process is sensitive to errors (11).

In the literature, there are some articles which evaluate for the affect of pandemic on the total testing process (12, 13). However, our study is the first to evaluate the impact of the pandemic on the turn around time at a public health laboratory in Turkey. However, testing for COVID-19 in our city did not performed by our laboratory; as a result of this, our study did not evaluate the possible higher workload of our laboratory and staff. This is the main disadvantage of our study. Further studies may be helpful to enlighten this issue.

As a result, TAT can be evaluated as a benchmark of the laboratory performance. Workload of the laboratories should be taken into consideration is specific situations, like pandemic.

DECLARATIONS

Funding
None

Conflicts of Interest/ Competing Interests
None

Ethics Committee Approval
Our study was approved by the Local Ethics Committee of Ordu University Faculty of Medicine (protocol ID: 2022/147).

Availability of Data
Available upon request.

Authors' Contributions
Murat Cihan conceived and designed the analysis. Muhammed Fevzi Kilinckaya collected the data, performed the analysis and wrote the paper.

REFERENCES

1. Watts NB. Reproducibility (precision) in alternate site testing. A clinician's perspective. Arch Pathol Lab Med. 1995;119:914-7.
2. Neuberger J, Peters M. The clinical interface--a British physician's view. Clin Chim Acta. 1996;248:11-8. doi: 10.1016/0009-8981(95)06262-9.
3. Kilinckaya MF, Yucel Ç, Turhan T. An evaluation of efficiency in an emergency laboratory by turnaround time. Int J Med Biochem. 2018;1:57-61. DOI: 10.14744/ijmb.2018.98698
4. Lundberg GD. Acting on Significant Laboratory Results. JAMA. 1981;245:1762-3. doi: 10.1001/jama.1981.03310420052033.
5. Griffin M, Sohrabi C, Alsafi Z, Nicola M, Kerwan A, Mathew G, et al. Preparing for COVID-19 exit strategies. Ann Med Surg (Lond). 2021;61:88-92. doi: 10.1016/j.amsu.2020.12.012
6. Ogutlu H. Turkey's response to COVID-19 in terms of mental health. Ir J Psychol Med. 2020;37:222-5. doi: 10.1017/ipm.2020.57. Epub 2020 May 21.
7. Hawkins RC. Laboratory turnaround time. Clin Biochem Rev. 2007;28:179-94.
8. Coetzee LM, Cassim N, Glencross DK. Weekly laboratory turn-around time identifies poor performance masked by aggregated reporting. Afr J Lab Med. 2020;9:1102. doi: 10.4102/ajlm.v9i1.1102
9. Cheng P, Rieta R, Bowen R. Evaluation of turn-around-time (TAT) of emergency department specimens after computerized autoverification. Clinical Biochemistry . 2008;41:1265-.
10. Goswami B, Singh B, Chawla R, Gupta VK, Mallika V. Turn Around Time (TAT) as a Benchmark of Laboratory Performance. Indian J Clin Biochem. 2010;25:376-9. DOI: 10.1007/s12291-010-0056-4
11. Lippi G, Simundic AM, Plebani M. Potential preanalytical and analytical vulnerabilities in the laboratory diagnosis of coronavirus disease 2019 (COVID-19). Clin Chem Lab Med. 2020;58:1070-6. DOI: 10.1515/cclm-2020-0285
12. Eren F, Tuncay ME, Oguz EF, Neselioglu S, Erel O. The response of total testing process in clinical laboratory medicine to COVID-19pandemic. Biochem Med (Zagreb). 2021;31:020713. doi: 10.11613/BM.2021.020713
13. Ahmed S, Jahan F, Naeem Effendi MU, Ghani F. Impact of COVID-19 on the pre and post analytical clinical laboratory testing processes-A performance evaluation study using six sigma. Annals of Medicine and Surgery. 2021;70:102842. DOI: 10.1016/j.amsu.2021.102842