

# The importance of hospital re-accreditation: improving the timeliness of laboratory critical value reporting

DOI: <https://doi.org/10.22435/hsji.v12i2.3315>

Wahyu Febrianto<sup>1</sup>, Menis Rahmawati<sup>2</sup>, I Gede Sastrawan<sup>3</sup>, Tita Hariyanti<sup>4</sup>

<sup>1</sup>Pindad General Hospital, Malang, East Java, Indonesia

<sup>2</sup>HVA Toelongredjo Hospital, Kediri, East Java, Indonesia

<sup>3</sup>Public Health Center Kintamani 3, Bangli, Bali, Indonesia

<sup>4</sup>Magister Hospital Management, Brawijaya University, Malang, Indonesia

Corresponding author: Wahyu Febrianto

Email: [wahyufebriantomd@gmail.com](mailto:wahyufebriantomd@gmail.com)

Received: July 29, 2020; Revised: August 2, 2021; Accepted: August 30, 2021

## Abstract

**Background:** Patient safety is the main issue in healthcare services nowadays. Delaying to inform the critical value of laboratory results is a significant source of harm for the patient. The aim of this study is to compare the timeliness of laboratory critical value reporting before and after re-accreditation as one of the service quality indicators in Hospital X.

**Methods:** This study was done by using observational cross-sectional in Hospital X on January - February 2020 with total sampling method of critical value reporting to the responsible clinician that originated from Intensive Care Unit (ICU), Verlos Kamer (VK), and inpatient ward (IW) 1-6 from January-December 2019. The timeliness of reporting was counted since the laboratory result was obtained until received by the responsible clinician within  $\leq 30$  minutes and categorized as "On time" or "Late".

**Results:** During 2019, there were 816 reporting which has been done before re-accreditation (511) and after re-accreditation (305) with 17 kinds of tests. The most reported test was platelet with 349 (before re-accreditation) and 101 (after re-accreditation), whilst SGOT/SGPT and albumin were the fewest one. The lowest timeliness of reporting percentage was 76,00% (February), whilst the highest was 98,48% (November). The timeliness of reporting's percentage was 84,34% (before re-accreditation) and 94,43% (after re-accreditation). The statistical analysis result revealed Pearson Chi-Square correlation was 18,535 with significance 0,000 and 3,145 odds ratio which shows that re-accreditation could significantly increase the timeliness of critical value reporting three times.

**Conclusion:** This result showed that re-accreditation could affect the timeliness of laboratory critical value reporting to the responsible clinicians. (*Health Science Journal of Indonesia 2021;12(2):81-7*)

**Keywords:** re-accreditation, critical value, laboratory, patient safety, hospital

## Abstrak

**Latar belakang:** Keselamatan pasien merupakan isu utama dalam pelayanan kesehatan. Tertundanya komunikasi hasil nilai kritis laboratorium merupakan sumber bahaya yang signifikan terhadap pasien. Penelitian ini bertujuan untuk membandingkan ketepatan waktu pelaporan nilai kritis laboratorium sebelum dan setelah reakreditasi sebagai salah satu indikator mutu di RS X.

**Metode:** Penelitian dilakukan dengan cara observasional dengan metode cross sectional di RS X pada Januari - Februari 2020 dengan total sampling laporan nilai kritis kepada Dokter Penanggung Jawab Pasien (DPJP) yang berasal dari ruang Intensive Care Unit (ICU), Verlos Kamer (VK), dan ruang rawat inap 1 - 6 sejak Januari - Desember 2019. Ketepatan waktu pelaporan dihitung sejak hasil pemeriksaan didapatkan hingga diterima oleh DPJP dalam waktu  $\leq 30$  menit dan dinyatakan sebagai "Tepat Waktu" atau "Terlambat".

**Hasil:** Selama tahun 2019, terdapat 816 pelaporan yang dilakukan sebelum akreditasi (511) dan setelahnya (305) dengan 17 jenis pemeriksaan. Pemeriksaan trombosit menjadi yang paling banyak dilaporkan yaitu 349 (sebelum akreditasi) dan 101 (setelah akreditasi), sedangkan SGOT/SGPT dan albumin menjadi yang paling sedikit. Persentase ketepatan waktu pelaporan paling rendah adalah 76,00% (Februari) sedangkan yang paling tinggi adalah 98,48% (November). Persentase ketepatan waktu pelaporan didapatkan 84,34%

(sebelum akreditasi) dan 94,43% (setelah akreditasi). Hasil analisis statistik didapatkan korelasi Pearson Chi-Square 18,535 dengan signifikansi 0,000 dan Odds ratio 3,145 menunjukkan re-akreditasi mampu meningkatkan kemungkinan ketepatan waktu pelaporan nilai kritis sebesar tiga kali lipat.

**Kesimpulan:** Hal ini menunjukkan bahwa re-akreditasi mampu mempengaruhi ketepatan waktu pelaporan nilai laboratorium kritis kepada DPJP. (*Health Science Journal of Indonesia 2021;12(2):81-7*)

**Kata kunci:** re-akreditasi, nilai kritis, laboratorium, keselamatan pasien, rumah sakit.

The main issue in health services nowadays is patient safety. Every year, adverse events occur as many as 134 million cases in the hospital of middle-low income countries and are responsible for 2,6 million death because of unsafe care. It also estimated 1 of the 10 patients in a high-income countries is harmed by a various unwanted events during getting service in the hospital which half of it is preventable.<sup>1</sup>

The patient safety regulation in Indonesia is reflected on Ministry of Health Decree No.496/Menkes/SK/IV/2005 about Medical Audit Guideline in Hospital which has main purpose is to achieve medical service excellence, minimize medical error, and give safety to patients in the hospital. Indonesian Hospital Association (PERSI) also initiate meeting and persuade all the hospital stakeholder to be more concerned about the patient safety issue.<sup>2</sup>

Hospitals in Indonesia must be accredited once every 3 years in order to increase the quality of care according to Indonesia law about hospitals (Undang-Undang No. 44 Tahun 2009, Pasal 40 Ayat 1). Hospital X which was established in 1907 is a type C hospital with 194 beds inside. It has been accredited four times: once in 2011 with five primary service standards (administration, medical record, emergency, medical, and nursing service), twice in 2012 & 2016 with KARS (Komite Akreditasi Rumah Sakit) standard, and once in 2019 with SNARS 1<sup>st</sup> edition (Standar Nasional Akreditasi Rumah Sakit) criteria which got the best category (paripurna) as written on the certificate with the serial number is KARS.SERT/866/VII/2019.

Indonesia has 12 compulsory national quality indicators for hospitals which laboratory critical value reporting is one of them. *The Joint Commission* (JC) implies critical value is a test result that is significantly out of normal range and represents life threatening condition.<sup>3</sup> Hospital X policy declares that laboratory critical value reporting must be received by a responsible clinician within  $\leq 30$  minutes with the target of achievement being 100%.<sup>4</sup> The laboratory critical value was stated on hospital's

internal regulation that was published in April 2019 which contains the critical value of hematology, clinical chemistry, electrocardiography, and radiology. This regulation was socialized together with re-education about critical value reporting for the safety of patients.

This research purpose is to compare the timeliness of laboratory critical value reporting before and after re-accreditation and in Hospital X. This study could be one of the evidence whether re-accreditation can increase the quality of hospital services.

## METHODS

This study has been done by using the observational cross-sectional method from January to February 2020. The population of this study was 821 data obtained from laboratory critical value reporting documentation in Hospital X from January-December 2019. Data was originated from the Intensive Care Unit (ICU), *Verlos Kamer* (VK) or delivery room, and inpatient ward 1-6 which has well documented report. The method of sampling in this study was purposive total sampling. There were 5 data that do not meet the sample criteria, so the sample that accepted was 816 data.

The data about amount of laboratory results during 2019 was obtained from Hospital's Information System. There were 15.734 laboratory test results divided as 7.854 before and 7.880 after re-accreditation. This data describes how many laboratory test results have been delivered to 8 hospital rooms as mentioned above. The variable of this study is re-accreditation execution and the timeliness of laboratory critical value reporting before and after re-accreditation. Re-accreditation is an activity that has been held by the hospital along with KARS on July 8<sup>th</sup> - 12<sup>th</sup>, 2019. The laboratory test results performed January - July 7<sup>th</sup>, 2019 defined as "before re-accreditation", whilst July 8<sup>th</sup> - December 31<sup>th</sup>, 2019 defined as "after re-accreditation".

The timeliness of laboratory critical value reporting is reporting laboratory test results that are included in the critical criteria (according to Hospital X regulation) to responsible clinician whether verbal or written until received within  $\leq 30$  minutes and proven by therapy advice or SBAR (situation, background, assessment, and recommendation) documentation on medical record.<sup>5</sup> Regardless of the amount and type of critical laboratory result reported, it only counted as 1 report if it is the same patient and reported at the same time. The result of reporting was classified as “On Time” or “Late”.

The hypothesis of this research is hospital re-accreditation could affect the timeliness of laboratory critical value reporting to the responsible clinicians. The samples were tabulated and Chi-Square was performed as a statistical analysis method on SPSS 20 application to prove the hypothesis. Ethical approval from the ethics commission of the hospital was given as ethical clearance letter No. SURKT/RST/20.09.05.001 on September 5<sup>th</sup>, 2020.

## RESULTS

We found 816 documentation about laboratory critical value reporting to responsible clinicians consisting of 17 tests variation (Table 1) among it. Before re-accreditation there were 538 critical

results and 344 critical results afterward. Platelet test was the most test with critical result whether before or after re-accreditation as many as 349 (64,9%) and 101 (29,4%) respectively (Table 1). On the contrary, SGPT/SGOT and albumin were the fewest tests with the critical results.

Table 1. Laboratory critical result by type of test

Test	Before Re-accreditation (%)	After Re-accreditation (%)
Platelet	349 (64,9)	101 (29,4)
Leucocyte	24 (4,5)	88 (25,6)
Hemoglobin	51 (9,5)	67 (19,5)
Hematocrit	-	2 (0,6)
APPT	3 (0,6)	-
BUN	7 (1,3)	6 (1,7)
Creatinine	39 (7,2)	25 (7,3)
Uric Acid	2 (0,4)	-
Potassium	33 (6,1)	25 (7,3)
Calcium	4 (0,7)	-
Sodium	5 (0,9)	9 (2,6)
Random blood sugar	9 (1,7)	5 (1,5)
Troponin	9 (1,7)	12 (3,5)
Total bilirubin	2 (0,4)	1 (0,3)
HBsAg	1 (0,2)	1 (0,3)
SGOT / SGPT	-	1 (0,3)
Albumin	-	1 (0,3)
Total	538 (100)	344 (100)

Table 2. Laboratory test results, critical laboratory test results, critical value reporting before and after re-accreditation

Room	Before Re-accreditation			After Re-accreditation		
	Laboratory Test Results	Laboratory Test Results with Critical Value	Critical Value Reporting	Laboratory Test Results	Laboratory Test Results with Critical Value	Critical Value Reporting
ICU	190	39	38	156	38	35
VK	1.018	18	18	827	15	14
IW 1	459	55	53	344	44	34
IW 2	627	77	71	634	33	32
IW 3	1.566	61	57	1.625	26	24
IW 4	1.091	86	86	1.179	70	60
IW 5	1.377	143	136	1.520	69	63
IW 6	1.526	59	52	1.595	49	43
<b>Total (%)</b>	<b>7.854 (100)</b>	<b>538 (6,9)</b>	<b>511 (95)</b>	<b>7.880 (100)</b>	<b>344 (4,4)</b>	<b>305 (88,7)</b>

We obtained 15.734 laboratory test results (7.854 before and 7.880 after re-accreditation) were delivered to the Intensive Care Unit (ICU), *Verlos Kamer* (VK) or delivery room, and inpatient ward (IW) 1-6 during 2019 (Table 2). Before re-accreditation, 538 (6,9%) from 7.854 laboratory test results were critical values. The laboratory critical value reporting was 511 (95%) out of 538 laboratory test results with critical values. After re-accreditation, 344 (4,4%) from 7.880 laboratory test results were critical value. The laboratory critical value reporting was 305 (88,7%)

out of 344 laboratory test results with critical value. The difference about the number of reporting and the documented critical laboratory results (e.g. before re-accreditation 511 reporting from 538 critical results) happened because we only count as 1 report if it is the same patient and reported at the same time regardless of the amount and type of critical laboratory result reported. For the example, we found many test results from the same patient at the same time of reporting such as critical platelet count accompanied by critical leucocyte count or critical Blood Urea Nitrogen (BUN) result accompanied by critical of the creatinine serum.

Table 3. Timeliness critical value reporting before and after re-accreditation

Room	Before Re-accreditation		After Re-accreditation		Pearson X <sup>2</sup> Correlation	Sig.	OR
	On Time	Late	On Time	Late			
ICU	34	4	34	1	18,535	0,000	3,145
VK	17	1	14	-			
IW 1	43	10	34	-			
IW 2	62	9	26	6			
IW 3	48	9	24	-			
IW 4	71	15	57	3			
IW 5	114	22	63	-			
IW 6	42	10	36	7			
<b>Total (%)</b>	<b>431 (84,34%)</b>	<b>80 (15,66%)</b>	<b>288 (94,43%)</b>	<b>17 (5,57%)</b>			

The data of laboratory critical value reporting to responsible clinicians was obtained from ICU, VK, and inpatient ward (IW) 1-6 (Table 3). VK was the room with the fewest amount of reporting whether before and after re-accreditation with 18 reports (17 on time and 1 late) and 14 reports (on time) respectively. IW 5 was the room with the most reporting with 136 reports (114 on time and 22 late) before re-accreditation and 63 reports (on time) after re-accreditation. The most amount of reporting delay was coming from inpatient ward 5 before the re-accreditation. After re-accreditation, the lateness of reporting was zero on VK, inpatient wards 1, 3 and 5. The percentage of laboratory critical value reporting before re-accreditation was 84,34% on time and 15,66% late while after re-accreditation there was an improvement with 94,43% on time and 5,57% late.

The timeliness of critical value reporting's trend from January until December 2019 could be seen in picture 1. The timeliness of laboratory critical value reporting is reporting laboratory test results that are

included in the critical criteria (according to Hospital X regulation) to responsible clinician whether verbal or written until received within  $\leq 30$  minutes and proven by therapy advice or SBAR documentation on medical record.<sup>5</sup> The highest enhancement of the timeliness percentage happened in May from 84,47% to 96,49%. The fewest reporting's percentage happened in February 2019 with 76,00%, whilst the most happened in November 2019 with 98,48%. The statistical analysis of laboratory critical value reporting with Chi-Square method has met the condition with expected count values on all cells  $> 5$ , and Pearson Chi-Square Correlation result was 18,535 with significance 0,000 (Table 3). It means there is a significant differences in the timeliness of critical value reporting before and after re-accreditation group. The odds ratio of the test is 3,145. It means the chance of timeliness of critical value reporting is increased as high as three times because of re-accreditation. This analysis showed that re-accreditation could affect the timeliness of laboratory critical value reporting to the responsible clinicians.

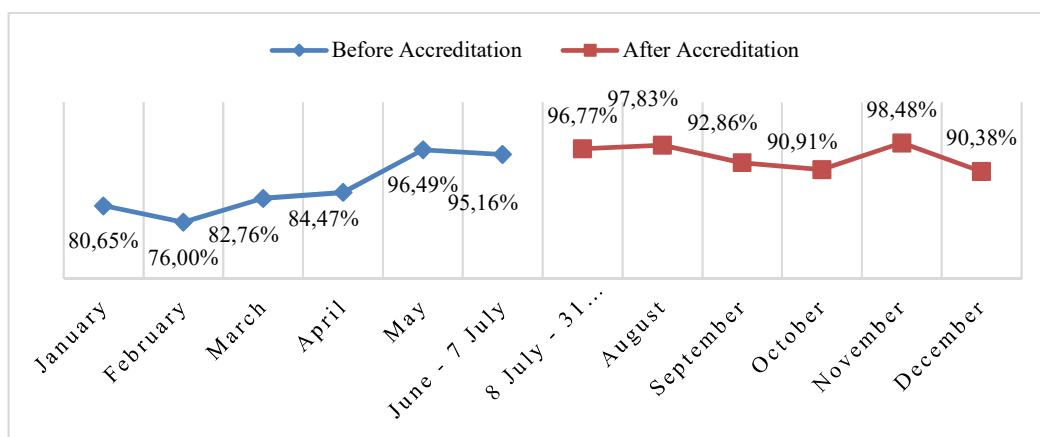


Figure 1. The percentage of laboratory critical value reporting to responsible clinician

## DISCUSSIONS

We identified 17 laboratory test variations that have critical value and reported them to the responsible clinicians. The most laboratory test result with critical value was platelet followed by leucocyte and hemoglobin as mentioned in Table 1. A study in India from January 2012 to December 2013 found 5 laboratory test results with the most critical value that informed to responsible caregiver were hemoglobin 26,8%, 17,1% leucocyte, urine ketone 16,0%, platelet 10,4%, and International Normalized Ratio (INR) 10,1%.<sup>6</sup> Yang *et al.*, unveiled critical value of platelet, total leucocyte, and INR were 3 out of 10 laboratory tests that has strong association with the occurrence of death in patients.<sup>7</sup> Platelet count is one of the indicators as coagulation representative along with other indicators (respiration, liver, central nervous system (CNS), and renal) in Sequential (sepsis-related) organ failure assessment (SOFA) Score which could define septic condition which can lead multiorgan dysfunction syndrome and shock that result in death.<sup>8,9</sup> So, it is very important for caregivers to understand the vital role of laboratory test critical value and to report it as soon as possible to the responsible clinicians.

The critical laboratory test result percentage in our result is relatively high 4,4% (July-December 2019) and 6,9% (January-July 2019) as seen in Table 2. On the other study, the percentage is ranging from 0,4% (January - June 2017); 0,49% (January 2015 - June 2019); 0,96% (January - December 2010) and 1,02% (May - June 2015).<sup>10,11</sup> The difference is we only analyze the laboratory test result from the inpatient ward which has a higher chance to contribute to critical value, whereas the previous study involved the emergency and outpatient departments.<sup>10,6</sup> For the example low platelet count  $\leq 100.000/\mu\text{L}$  (thrombocytopenia) and increasing hematocrit  $>20\%$  are the laboratory criteria for hospitalization on DHF cases with clinical symptoms which prone to get critical value in inpatient ward.<sup>14</sup>

The hospital target about laboratory critical value reporting yet achieved as they established the target is 100%. The highest achievement from the target was 98,48% that happened in November 2019 (Figure 1). In another word, there was still a lateness in critical value reporting. A study in a clinical laboratory of a university hospital in Turkey shows there was a lateness of reporting as many as 13,1% out of 2018 laboratory critical value results

during May-June 2015. They found 62,8% was mild-delayed reporting ( $18,5 \pm 4,4$  minutes) and 37,2% was advanced-delayed reporting ( $47,1 \pm 11,3$  minutes). The lateness of critical value reporting is usually happens from 06.00 - 10.00 which is the beginning of working time and the busiest time of the day. The lateness was also observed from 12.00 - 14.00 (lunch time) and at from 16.00 - 18.00 which is changing time of the personnel. The reason for the lateness of reporting is morning visits preparation and the changing of the task of the personnel during those hours. The conclusion of the study is relatively increasing workload and less effective workflow planning caused the delay in critical value reporting.<sup>13</sup>

Lack or delay in critical value communication is one of significant sources of harm for patients. Lundberg in 1972 defined critical value concept as "pathophysiologic derangement that varies so much from normal that it is life threatening if therapy is not started immediately".<sup>15</sup> Those danger alarms are well understood by doctors that was proven by changes in therapy for 98% of patients in the surgical department and 91% of patients in the non-surgical department after the critical value obtained.<sup>3</sup> On the other study, delays in antibiotic administration for sepsis, severe sepsis, and septic shock patient were associated with the risk of mortality in the hospital.<sup>16</sup> In children patient, the delay of discovering critical value not only can cause death, but also development impairment such as neurological e.g. which caused by hyperammonemia that attacks the brain.<sup>17</sup> So, it is very important for the responsible physicians to know about their patient's critical laboratory results as soon as possible, because delay in knowing means delay giving a prompt treatment.

With the rush of doctors who are not always in the inpatient room, 55,6% of laboratory critical results have been reported to other health workers than straight to responsible clinicians. Howanitz *et al.*, demonstrate there are different mindsets between doctors and nurses about the urgency of critical value reporting. The nurse assumes that critical value reporting is not important to the patient's medication, while the doctor thinks conversely. Thus, education for health workers about awareness of critical value reporting to the responsible clinicians is needed for the safety of patients.<sup>18</sup> The socialization about the urgency of critical value reporting in Hospital X has been held as re-accreditation preparation. Nowadays, critical value communication is the part of accreditation procedure of medical laboratories

and including in universally agreed International Organization for Standardization (ISO) 15189:2012.<sup>3</sup>

The total percentage of timeliness of laboratory critical value reporting to responsible clinicians was increased from 84,34% to 94,43% after re-accreditation (Table 3). Statistical analysis reveals re-accreditation increase the timeliness of reporting as high as three times. Despite the highest enhancement of the timeliness of critical value reporting's percentage was happened in May 2019 (picture 1) from 84,47% to 96,49%, the timeliness of laboratory critical value reporting was always >90% after re-accreditation. It could be influenced by the internal regulation publication about critical value in April 2019 and re-education about the importance of laboratory critical value reporting for the safety of patients. The intervention of training to increase knowledge, practice and attitude of staff towards compliance of critical value reporting to the clinician could increase the timeliness. The study in India shows the timeliness of critical value reporting was 97,22% before training and became 100% after the training.<sup>19</sup> Study in a University Hospital, Saudi Arabia shows the percentage of laboratory critical value reporting within 30 minutes had high compliance (99,37%) as they already stick to the College of American Pathologists (CAP) Laboratory Accreditation Program.<sup>20</sup> It seems accreditation and the sequence like training could bring a good impact to the timeliness of laboratory critical value reporting.

The limitation of this research is using secondary data which the accuracy depends on the data maker. The other limitation is we do not have data from the emergency department which could be the best source of laboratory test result which has critical value. This study could be expanded further with more complete data or to be performed in another hospital which could provide evidence about the benefit of re-accreditation in the Hospital.

In conclusion, our study found there is significant differences of timeliness laboratory critical value reporting before and after re-accreditation. Hospital re-accreditation and the sequence like education could increase the timeliness of the laboratory critical value reporting. It is very crucial to report the laboratory critical value result as soon as possible because it is inseparable with patient safety.

## REFERENCES

1. WHO. Patient Safety [Internet]. Factsheet. 2019 [cited 2020 Jan 23]. p. 1. Available from: <https://www.who.int/news-room/fact-sheets/detail/patient-safety>
2. Kementerian Kesehatan. Keputusan Menteri Kesehatan Republik Indonesia tentang Pedoman Audit Medis di Rumah Sakit. Indonesia; 2005.
3. Lippi G, Mattiuzzi C. Critical laboratory values communication: Summary recommendations from available guidelines. *Ann Transl Med.* 2016;4(20):2–5.
4. KARS. Standar Nasional Akreditasi Rumah Sakit. 1st ed. KARS, editor. Standar Akreditasi Rumah Sakit. Jakarta: KARS; 2017. 421 p. Indonesian,
5. Kemenkes RI. Keputusan Direktur Jenderal Pelayanan Kesehatan Kementerian Kesehatan RI No.HK.02.03/I/2642/2016 Tentang Perubahan Keputusan Direktur Jenderal Pelayanan Kesehatan Kementerian Kesehatan RI No.HK.02.03/I/0147/2016 Tentang Indikator Kinerja Terpilih (IKT) Ta. Indonesia; 2016.
6. Desai KN, Chaudhari S. Analysis of Critical values in NABL (National Accreditation Board for Testing and Calibration Laboratories) accredited Hematology and Clinical Pathology laboratory. *Ann Appl Bio-Sciences.* 2017;4(1):A14–8.
7. Yang Z, Tan EH, Li Y, Lim B, Metz MP, Loh TP. Relative Criticalness of Common Laboratory Tests for Critical Value Reporting. *J Clin Pathol.* 2019;72(4):325–8.
8. Gyawali B, Ramakrishna K, Dhamoon AS. Sepsis: The evolution in definition, pathophysiology, and management. *SAGE Open Med.* 2019;7: 205031211983504.
9. Kaukonen KM, Bailey M, Suzuki S, Pilcher D, Bellomo R. Mortality related to severe sepsis and septic shock among critically ill patients in Australia and New Zealand, 2000-2012. *JAMA - J Am Med Assoc.* 2014;311(13):1308–16.
10. Li R, Wang T, Gong L, Dong J, Xiao N, Yang X, et al. Enhance the effectiveness of clinical laboratory critical values initiative notification by implementing a closed-loop system: A five-year retrospective observational study. *J Clin Lab Anal.* 2020;34(2):1–10.
11. Yang D, Zhou Y, Yang C. Analysis of Laboratory Repeat Critical Values at a Large Tertiary Teaching Hospital in China. *PLoS One.* 2013;8(3):11–4.
12. Arbiol-Roca A, Corral-Comesaña S, Cano-Corres R, Castro-Castro MJ, Dastis-Arias M, Dot-Bach D. Analysis of laboratory critical values at a referral Spanish tertiary university hospital. *Biochem Med.* 2019;29(1):1–11.
13. Özcan O, Çakırca G, Motor S, Yönden Z. Klinik laboratuvarlardan kritik değerlerin sorumlu sağlık personeline bildiriminde gözlenen gecikmeler. *Turkish J Biochem.* 2017;42(1):45–50.
14. Tursinawati Y, Ramaningrum G, Aprilia I. Laboratory Finding and Clinical Manifestation Affecting the

- Length of Stay of Hospitalization. Pros Semin Nas Int Muhammadiyah Univ Semarang. 2017;130–5.
15. Layfield LJ. Critical values: Has their time arrived for cytopathology? *Cancer Cytopathol.* 2014;122(3):163–6.
  16. Liu VX, Fielding-Singh V, Greene JD, Baker JM, Iwashyna TJ, Bhattacharya J, et al. The timing of early antibiotics and hospital mortality in sepsis. *Am J Respir Crit Care Med.* 2017;196(7):856–63.
  17. Sergi C. Promptly reporting of critical laboratory values in pediatrics: A work in progress. *World J Clin Pediatr.* 2018;7(5):105–10.
  18. Özcan O, Çakırca G, Motor S, Yönden Z. Delays in Reporting Critical Values from Clinical Laboratories to Responsible Healthcare Staff. *Turkish J Biochem.* 2017;42(1):45–50.
  19. Bhatia K, Bhatia P, Udari SN, Patil N. Study on laboratory critical value analysis in a multi-speciality hospital. *MedPulse Int J Biochem.* 2019;12(1):06–9.
  20. Shawan D Al. The effectiveness of the joint commission international accreditation in improving quality at king fahd university hospital, saudi arabia: A mixed methods approach. *J Healthc Leadersh.* 2021;13:47–61.