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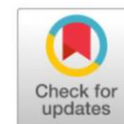# JURNAL TEKNOLOGI LABORATORIUM

**Original Research**

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## Antibacterial Blood Sample on the Stability of Hematological Examination

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**Abstract:** Transportation accounts for quite large errors up to 12% of the total errors. The error factor in this transportation activity comes from sending specimens that are too long and storage temperatures that are not right. Hematological examination is an examination that is often performed in various health services. The purpose of this study was to determine the stability of the hematological examination of blood samples transported for 1 hour and 2 hours at room temperature and cold temperatures. This study is a laboratory experimental study. Observations before treatment were controls, and treatments were carried out after 1 hour and 2 hours of transportation at room temperature and cold temperatures. This research was conducted at an average ambient temperature of 33.4ºC and humidity of 45%, room temperature of 27.8ºC and humidity of 43%, cold temperature of 4.5ºC and humidity of 52%, average shock of 54.9. The results showed that the parameters of Hgb, PLT, WBC, NEUT were stable for up to 2 hours in both room temperature and cold conditions. Meanwhile, the stability of LYMPH parameters is only capable at room temperature for 2 hours. Parameters Hct, RBC, MCV, MCHC and MXD there are differences in the results of the examination at cold temperatures after 1 hour and 2 hours. However, the parameters of RBC, MCV and MXD were stable for up to 1 hour at room temperature. We conclude that the hematological examination is stable for up to 1 hour with the recommended storage at room temperature. Only Hgb, PLT, WBC, NEUT tests are stable for up to 2 hours in both room temperature and cold conditions.

**Keywords:** Hematology, stability, transportation, time, temperature.

## INTRODUCTION

Transportation accounts for quite large errors up to 12% of the total errors. The error factor in this transportation activity comes from sending specimens that are too long and the storage temperature is not right.[1,2] Hematology examination is an examination that is often carried out in various health services.[1,3,4] Regulation of the Minister of Health of the Republic of Indonesia Number 43 of 2013 stipulates the length of time for delaying hematological examinations to reach 2 hours except for Hct, which is 6 hours at room temperature.[4] Meanwhile, the International Council for Standardization in Haematology (ICSH) recommends a delay at room temperature not exceeding 4 hours and for diffcout not exceeding 1 hour, a delay at 4ºC reaching 24 hours to 72 hours and for diffcout reaching 8 hours.[5] The problem is that there are no reports on the stability of hematological examinations that are influenced by temperature and time on specimen transportation.

Clinical laboratories have a role in making doctor's decisions towards patients, about 60% to 70% of laboratory results can underlie the doctor's decisions.[6] These decisions include establishing a diagnosis by determining the

cause of the disease, supporting an early warning system, monitoring treatment, maintaining health, and preventing the onset of disease.[4] Therefore, if this does not receive special attention, it can have an impact on the accuracy of laboratory examinations and can subsequently lead to misinterpretation by doctors so that it can have an impact on inappropriate treatment periods and even death.

Transport of specimens must meet the requirements for long delivery times that do not exceed the stability of the examination, are not exposed to sunlight and stored at a certain temperature.[7] Storage at cold temperatures (±4ºC) aims to inhibit blood cell metabolism which can prolong the life span and maintain cell morphology, so that the stability of the examination becomes longer. However, frozen blood specimens (±-4ºC), resulted in lysis of the specimen. In addition, mechanical factors such as shocks can also cause specimens to easily lyse.[8–10] Based on this, this study aims to determine the stability of the hematological examination of blood samples transported for 1 hour and 2 hours at room temperature and cold temperatures.

## MATERIAL AND METHOD

This research is a laboratory experimental study with a pre-experimental research design through a onegroup pretest-posttest design approach. The study used human blood specimens which were then divided into two groups, namely room temperature and cold spoons. Observations before treatment were controls, and treatments were carried out after 1 hour and 2 hours of transportation. This research has been approved by the research ethics commission of Universitas Nahdlatul Ulama Surabaya with the number 091/EC/KEPK/UNUSA/2021. A total of 15 people participated in this study voluntarily.

Venous blood samples were taken from the fossa antecubital area using a K2-EDTA tube (BD Vacutainer, Becton Dickinson, USA). Each respondent was taken as many as 2 tubes with each volume of 3 cc. The samples obtained were immediately analyzed as research controls. Then the 1st tube is put in a transport container without ice (room temperature) and the 2nd tube is inserted into a transport container filled with ice (cold temperature). The containers were carried by motorized vehicles around the road, after 1 hour and 2 hours the analysis was carried out again.

Hematology analysis was performed using the hematology analyzer Sysmex XP-300 (Sysmex Corp., Japan) by taking the parameters of hemoglobin (Hgb), hematocrit (Hct), erythrocyte count (red blood cell, RBC), platelet count (platelet, PLT), leukocyte count (white blood cell, WBC), count the type of leukocyte (diffcount), MCV (meancorpuscular volume), MCH (mean corpuscular hemoglobin) and MCHC (mean corpuscular hemoglobin concentration). In addition, temperature and humidity measurements were carried out in the transport container and the environment using a digital thermometer and hygrometer (Therm Scan, China), shock measurements during transportation using a lutronvibrasimeter VB 8200 (Lutron electronic, Taiwan).

Inferential data analysis begins with a normality test using the Shapiro-Wilk test, the data is normally distributed if the p value > with a significance level of 5% or at = 0.05. Hypothesis testing was carried out to determine the difference in the results of the treatment with the control using Anova parametric analysis with the same subject. Ratio data that were not normally distributed were analyzed by nonparametric Anova Friedeman. The test results stated that there was a significant difference if the p-value < with a two-tailed significance and a significance value of 5% or = 0.05. Analyzes were performed using SPSS version 21 (IBM, United States).

## RESULTS AND DISCUSSION

Maintaining examination stability is very important in laboratory services in order to maintain the quality of examination results, including hematology. This condition is generally found in laboratories that have a phlebotomy room far from the laboratory, sampling services in the field (homecare) or conducting examination referrals.[11]

During the study, the measured average ambient temperature was 33.4°C with an average humidity of 45%. The average temperature of the container without ice measured was 27.8°C with 43% humidity. The average temperature of the container with ice is 4.5°C with an average humidity of 52%. The average shock recorded in this study was 54.9. The results of this study are shown in Table 1.

Parameters of Hgb, PLT, WBC, NEUT are stable for up to 2 hours in both room temperature and cold conditions. While the stability of LYMPH parameters was only able at room temperature for a long time of 2 hours. Parameters Hct, RBC, MCV, MCHC and MXD there were differences in the results of the examination at cold temperatures after 1 hour and 2 hours. However, the parameters of RBC, MCV and MXD were stable for up to 1 hour at room temperature. While at room temperature parameters Hct and MCHC found differences in the results of the examination at 1 hour and no difference at 2 hours. The results of the unstable examination in this study, both at room temperature and cold temperatures, were the MCH parameter (Table 3).

Various studies related to examination stability have been published with various types of hematology analyzers. Publication of the stability of hematological examinations transported for 1 and 2 hours is still very limited, however, a study conducted by previous authors in the publication "Stability of routine hematological examinations on blood samples that were kept at room temperature using Cell-Dyn Ruby" showed that the parameters Hgb, Hct, RBC , MCV, MCH, MCHC, PLT, WBC and LYMPH were able to be stable at room temperature for up to 6 hours.[12]

When compared with various studies, the stability of hematological examination parameters with various hematology analyzers can give different results.[13–17] These differences can be influenced by various factors including the method used.[18] Uniquely, our study reported that the hematological examination was more stable at room temperature when transported.

Blood cells are cells that are easy to change if they are outside the blood circulation for a long time. Erythrocytes tend to change shape into spherocytes and crenation cells. Leukocytes generally undergo changes in the nucleus, granules, cytoplasm and vacuole formation. Meanwhile, the platelets changed shape to become spherical.[5,12,19–21] The stability of the examination in this study could be caused by these factors, generally it could be inhibited by a decrease in the storage temperature of the examination material. However, in this study, room temperature showed excellent examination stability. The shock factor that can affect the stability of specimens at cold temperatures cannot be explained because there are few publications regarding the stability of hematological examinations in transportation.

However, there are reports in other studies that unstable RBC parameters are caused by acid accumulation from cell metabolism and reduced ATP which causes RBC to change shape. Lack of ATP will also affect the RBC ionic pump so that it affects hemostasis which has an impact on the release of hemoglobin due to RBC lysis.[22] It could be that this condition causes the parameters of RBC and its derivatives to be unstable while HGB remains stable because the hemoglobin protein is still contained in the plasma. It was also reported in WBC, WBC morphological changes were associated with a decrease in ATP in cells and its decrease was associated with granulocyte degeneration.[22] WBC and NEUT are more stable than other leukocyte parameters, but it is still unclear because the number of studies is still small. However, we suspect that LYMPH and MDX morphological changes are faster than NEUT.

## CONCLUSION

Our results show that the hematological examination is stable for up to 1 hour with the recommended storage at room temperature. Only Hgb, PLT, WBC, NEUT tests are stable for up to 2 hours in both room temperature and cold conditions.

## AUTHORS' CONTRIBUTIONS

All authors contributed to the process of preparing this article.

## DATA AVAILABILITY STATEMENT

The utilized data in this investigation are available from the corresponding author on reasonable request

## DISCLOSURE STATEMENT

The views and opinions expressed in this article are those of the authors and do not necessarily reflect the official policy or position of any affiliated agency of the authors.

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