

**Supplement**

**Laboratory Service Process Checklist: Preventive Measures to Increase Blood Glucose Test Accuracy**

**Checklist Proses Pelayanan Laboratorium: Tindakan Preventif untuk Meningkatkan Akurasi Pemeriksaan Glukosa Darah**

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**ABSTRACT**

*The accuracy of the blood glucose test results is an essential measurement for hospital quality since it affects the plan, decision, and outcome of the treatment. This study aimed to develop a checklist model to improve the laboratory results accuracy. The checklist development is based on the laboratory services processes covering pre-analytic, analytic, and post-analytic stages, which are implemented in all blood glucose test requests during the study period (65 examinations), the first week of October 2020. The implementation resulted in no incidence of test inaccuracy when conformed with patient clinical information. The staff expressed that completing the checklist is quick and easy to complete (3-5 minutes) and beneficial. The problem occurs when staff works alone, causing delays in completing the checklist. Therefore, regular monitoring and evaluation are suggested to ensure compliance and divide the checklist into two stages. The pre-analytic stage is first carried out for all patients, followed by the analytical and post-analytic stages because the last two activities were located on different floors. In short, checklists are effective as preventive measures to increase the conformity of laboratory examination results with patient clinical information.*

**Keywords:** Laboratory checklist, patient safety, test accuracy

**ABSTRAK**

Ketepatan hasil pemeriksaan glukosa darah merupakan salah satu tolok ukur kualitas rumah sakit karena berpengaruh terhadap rencana, keputusan, dan hasil perawatan. Penelitian ini bertujuan untuk mengembangkan model *checklist* untuk meningkatkan ketepatan hasil laboratorium. Penyusunan *checklist* ini didasarkan pada proses pelayanan laboratorium yang meliputi tahap pra analitik, analitik, dan paska analitik yang selanjutnya diimplementasikan terhadap semua permintaan pemeriksaan glukosa darah selama waktu penelitian (65 pemeriksaan) pada minggu pertama bulan Oktober 2020. Hasil implementasi *checklist* menunjukkan bahwa tidak ada kejadian ketidaktepatan pemeriksaan apabila disesuaikan dengan informasi klinis pasien. Petugas menyatakan bahwa pengisian *checklist* cepat dan mudah diselesaikan (3-5 menit), dan bermanfaat. Permasalahan terjadi ketika petugas berdinasi sendiri sehingga menyebabkan terjadinya keterlambatan dalam pengisian kelengkapan *checklist*. Oleh karena itu, kegiatan monitoring dan evaluasi secara rutin disarankan untuk memastikan kepatuhan petugas serta membagi pengisian *checklist* dalam 2 tahap. Tahap pra analitik dilakukan pertama kali untuk semua pasien dilanjutkan dengan tahap analitik dan paska analitik karena kedua aktivitas ini berlokasi di lantai yang berbeda. Kesimpulan penelitian ini menunjukkan bahwa penggunaan *checklist* efektif sebagai tindakan preventif untuk meningkatkan kesesuaian hasil pemeriksaan laboratorium dengan informasi klinis pasien.

**Kata Kunci:** Checklist laboratorium, ketepatan pemeriksaan, keselamatan pasien

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## INTRODUCTION

As a part of medical support services, the laboratory department has an essential role in improving the quality of patient care (1). Hospitals need to pay attention and make efforts to increase the quality of laboratory services so that the services provided to patients improve. Laboratory quality is the degree of examination results based on the measurement results determined by the laboratory on the actual value by considering accuracy and precision (2). A laboratory examination is considered high quality if it has accuracy and precision value; thus, it benefits in determining the diagnosis and treatment of patients because 60-70% of patients' medical decisions are related to diagnosis and management, including laboratory services (3).

The results of a preliminary study conducted on 8-12 August 2020 at the X Hospital showed an inconsistency between the laboratory results of blood glucose tests and the patient's clinical information standards as much as 15 times, or 0.42% of all blood glucose tests carried out within the last nine months. The blood glucose test results are expected to be accurate and correspond to the patient's clinical condition so that medical treatment can be appropriately given.

Previous studies showed that the incidence of laboratory test errors was 0.012-0.6% of all examinations results and impacted 60-70% of patient diagnosis and management from all diagnoses based on laboratory test results (3,4). The errors in examination results can be caused by errors in the pre-analytic, analytic, and post-analytic stages (5). Based on previous studies, the error rate of laboratory examinations at each stage was the largest at the pre-analytic stage, namely 46-68.2%, while the analytic and post-analytic stages were 7-13% and 18.5-47%, respectively (1,5,6). It shows the necessity of improving laboratory quality at all stages, namely pre-analytic, analytic, and post-analytic stages (7).

The accuracy of blood glucose test results based on patients' clinical information is crucial for the hospital because it affects the therapy. The influencing factors on the accuracy of blood glucose test result are patient and sample preparation, sample collection, and examination methods in measuring blood glucose levels. Therefore, the error in examining blood glucose at the pre-analytic, analytic, and post-analytic stages may result in patient safety incidents.

The quality of laboratory examination for patient care must be continuously improved. It can be made through internal and external quality control (7). Laboratory staff must pay attention to all examination stages from pre- to post-analytic to achieve good service quality. After identifying the cause of errors, corrective action can be taken to reduce the incidence of errors and further improve the quality of laboratory services.

This study aimed to evaluate the checklist model to improve the accuracy of laboratory results. The results of this study are expected to assist the hospital in improving the conformity between the laboratory results of blood glucose tests and the patient's clinical information.

## METHOD

### Study Design

This study was conducted in three phases, which were

development, implementation test, and checklist evaluation. The checklist development was based on all procedures in the examination carried out by staff in laboratory services including, pre-analytic, analytic, and post-analytic stages. Based on these stages, discussions were held with the head of the laboratory to form a checklist. The following stage was the checklist trial carried out for nine days on all requests for laboratory services for the blood glucose test. The results of the checklist implementation, including staff's implementation compliance, constraints, solutions, and impact on laboratory examination results, were then evaluated. Evaluations were carried out on all patient requests for blood glucose tests from 2-10 October 2020, as many as 65 form requests and blood glucose laboratory results.

### Data Collecting and Processing

Data collection was carried out by observation using a laboratory service checklist on all requests of patient laboratory examinations carried out by laboratory staff. The checklist contains all activities performed by laboratory staff when providing services to patients at the pre-analytical, analytical, and post-analytic stages. Assessment on the laboratory staff's response on the checklist usage was carried out through a survey using google form and discussions with the laboratory head and laboratory staff.

The data processing technique was carried out by tabulating the results of laboratory service checklist filling, the google form questionnaire filling, and discussion. The interpretation of the study results was carried out by observing the completion of checklist filling and the conformity of laboratory examination results with the patient's clinical information. Evaluation on staff's response to the checklist was based on the results of the questionnaire and discussions with the head and laboratory staff.

## RESULTS

### Evaluation of Checklist Implementation

Evaluation of the usage of the laboratory service checklist carried out on 2-10 October 2020 is presented in Table 1. The results show no inconsistency between the examination results and the patient's clinical information standards after using the checklist. In contrast, before using the checklist, the incompatibility between laboratory examination results and the patient's clinical information standards was 15 times or 0.42% of all blood glucose tests carried out in the last nine months.

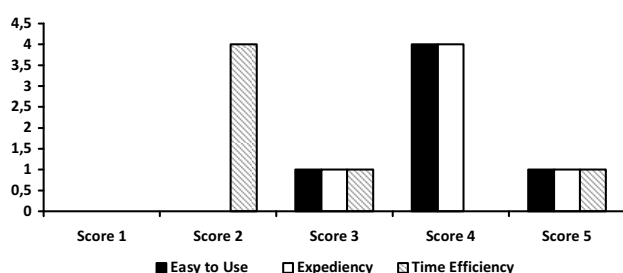
**Table 1. The result of the laboratory service checklist evaluation**

| No. | Criteria                                                     | Amount                   | Percentage |
|-----|--------------------------------------------------------------|--------------------------|------------|
| 1.  | Request for blood glucose laboratory tests                   | a. Outpatie examinations | 35         |
|     | a. Outpatient                                                | b. Inpatie examinations  | 30         |
|     | b. Inpatient                                                 |                          |            |
| 2.  | The results did not match the clinical information standards |                          | 0 0%       |
| 3.  | Checklist usage                                              | 65                       | 100%       |
| 4.  | Complete checklist                                           | 65                       | 100%       |
| 5.  | Incomplete checklist                                         | 0                        | 0%         |

The evaluation of the usage of laboratory service checklist sheets shows that the laboratory service checklist sheet has been used in each request. Besides, the compliance of laboratory staff on filling the laboratory service checklist is 100%, as evidenced by all checklist sheets that have been completely filled out according to the laboratory examination request.

#### *Evaluation of Laboratory Staff's Response*

Based on Figure 1, the results of laboratory staff's response evaluation to the implementation of the laboratory service checklist show that most staff (66.67%) stated filling out the checklist was fast and easy to complete (3-5 minutes) and useful in the laboratory services.



**Figure 1. Evaluation of laboratory staff response to checklist usage**

#### *Constraints and Solution for Checklist Implementation*

Discussions with laboratory staff revealed the ease, difficulty, and improvement plans. The staff stated that filling out the checklist can be done quickly due to checkmark. The checklist could be a tool for documenting the stage of inspection and errors made by the staff.

The difficulty experienced by the staff in using the checklists occurred in patients with referral laboratory examinations because clear and complete clinical condition information could not be obtained because the staff only received samples and examination sheets and could not directly see the patient's condition. Besides, when the staff is on duty alone (evening/night), filling out the checklist was possibly not done directly at the examination time due to limited staff and the number of patients served.

The solution to overcome blank or incomplete checklist due to the limited staff and the high number of patients served is by dividing the checklist into two stages. Documentation is carried out by filling out the pre-analytic stage first for all patients, followed by the analytical and post-analytic stages. This is done because the laboratory room is separated between the pre-analytic room on the 1st floor and the analytic and post-analytic room on the 2nd floor.

The checklist improvement plan is based on the discussion results with the head of the laboratory and the staff. The checklist sheet is given a column for the results of checking each examination step so that what is not suitable could be documented, including a column for patient's condition. Additionally, there is a need for a regular supervision schedule on staff compliance in implementing the procedures and the use of laboratory service checklist

sheets. The head of the laboratory also conveyed that it is necessary to add more laboratory analysts to meet the needs of staffs on the evening and night shifts.

## **DISCUSSION**

### *Implementation of Laboratory Service Checklists*

The study results show that checklist implementation results in no incidence of inconsistencies between the examination results and the patient's clinical information standards. All blood glucose tests have used the checklist (100%) and showed results corresponding to the patient information standards.

Each action performed in laboratory tests could be a source of error of the examination results. Based on previous study, the error rate of laboratory tests at the pre-analytical stage was the largest, namely 46-68.2%, while the analytic and post-analytic stages were 7-13% and 18.5-47%, respectively (1,5,6). It shows that efforts to improve the quality of laboratory services must be carried out at all stages of laboratory examinations, covering the pre-analytic, analytic, and post-analytic stages (7).

The impact of laboratory service checklist implementation in this study has been proven to increase the accuracy and eliminate the errors in laboratory examinations. The results of this study are in line with previous studies regarding the use of checklists in hospital services which are proven to reduce treatment errors and medication errors from 45.54% to 10.17% (8). In addition, other studies on the use of checklists in operating room services show that the use of checklists can reduce the mortality rate from 3.13% to 2.85% (9).

It is very important for laboratory staff to carry out verification in laboratory examinations to avoid result errors. Examination verification should be carried out at all stages of the examination, namely the pre-analytic, analytic, and post-analytic stages. Verification of the laboratory examination is carried out by using an instrument in the form of a laboratory service checklist.

The development of a checklist instrument is based on all stages in laboratory examinations, pre-analytic, analytic, and post-analytic. The documented laboratory examination stage will be a reference for the staff in controlling the service quality provided to patients.

The use of laboratory service checklists by the staff is one of the efforts made to reduce the incidence of inconsistencies between laboratory examination of blood glucose results and patient clinical information standards. Every patient undergoing a laboratory examination needs to include this checklist. The implementation of checklists in laboratory services are expected to reduce the occurrence of errors in laboratory examination results which will have an impact on errors in administering medical therapy to patients.

Errors that occur during examination stage can impact the quality of laboratory examination results. The results of previous studies show that the incidence of laboratory examination errors was 0.012-0.6% of all examinations results and impacted patients' diagnosis and management by 60-70% of all diagnoses based on laboratory examination results (3,4). This shows that laboratory examination service is one component needed to help diagnose a patient's disease.

Various risks of errors that occur in every stage of laboratory examination need to be anticipated by laboratory staff so that the examination results well. Reducing the risk of these errors is done by verifying and documenting using a checklist on each step taken by the staff during the laboratory examination. The laboratory service checklist is hoped to be a control function for laboratory staff in carrying out their duties properly to avoid the risk of unwanted errors, achieve quality examination results, and comply with patient clinical information standards.

#### *Factors Affecting Checklist Implementation*

The study results on the assessment of the laboratory staff's response to the implementation of laboratory service checklists showed that most staff (66.67%) stated filling out the checklist was fast and easy to complete (3-5 minutes) and useful in laboratory services. The discussion results with laboratory staff found that the number of staff, the number of patients served, and the ease of filling were the influencing factors of the checklist implementation. When the staff is on duty alone (evening/night), filling out the checklist was possibly not done directly at the examination time due to limited staff and the number of patients served. In addition, the use of checklist cannot be applied to referral laboratory examinations; clear and complete clinical condition information could not be obtained because the staff only received blood samples and examination sheets and could not directly see the patient's condition.

The ease of filling out the checklist also plays a role as a factor influencing the successful implementation of the checklist. Based on the discussion results with laboratory staff, checklist filling can be done quickly and easily by simply putting a checkmark. This is supported by the results of the questionnaire assessment regarding the ease and efficiency of filling out the checklist, which shows that 66.67% of staff feel easy in filling out the checklist and only took 3-5 minutes to complete. The ease and the lack of time required to fill out the checklist will be the factors that can increase staff compliance in using the laboratory service checklist.

The laboratory service checklist can be an instrument for laboratory staff to comply and orderly carry out all laboratory inspection steps to produce good quality laboratory examination. Staff compliance in carrying out laboratory service procedures will result in good service quality for patients (9).

#### *Outcome Implications*

This study is in line with the results of previous studies regarding the use of checklists in hospital services which are proven to reduce treatment errors, medication errors, and mortality rates. The impact of the application of laboratory service checklists has been proven to increase the examination result accuracy and reduce errors in laboratory examinations. The use of laboratory services checklists is expected to help hospital managers improve staff compliance in every laboratory service procedure. Monitoring and evaluation are one of the efforts to increase staff compliance in carrying out the checklist. Monitoring and evaluation activities are a form of supervision or control in organizations (10). Monitoring and evaluation aim to maintain continuity in the checklist usage in each laboratory service.

This study was only performed on blood glucose laboratory tests. Besides, the study was only carried out for nine days in the implementation of the laboratory service checklist, so that only a small part of the examination request and laboratory results could be observed to see the impact of using the checklist in increasing the suitability of laboratory examination results.

Further study regarding how much influence the checklists usage has in increasing the suitability of the examination results needs to be done. Besides, it is necessary to do a deeper study of the factors that affect the staff compliance in carrying out the checklist in laboratory examinations.

The hospital can perform a control function of laboratory services provided to patients through the use of a checklist. The laboratory service checklist used in providing laboratory services to patients is expected to maintain the quality of laboratory examination results. A laboratory examination is considered high quality if it has a value of accuracy and precision, so it provides benefits in determining the diagnosis and treatment of patients. The use of checklists is expected as a preventive measure in reducing the occurrence of errors in laboratory examination results as well as increasing the conformity of laboratory examination results with patient clinical information.

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