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Quality of Laboratory Request Forms and Reports in General Public Hospitals in Khartoum State, Sudan: A Cross-Sectional Study

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Abstract—Background*: Modern medical practice is progressively dependent on reliable clinical laboratory services. Proper filling of all the information needed on the laboratory forms and reports will assist diagnosis, hence patient care will be improved and resources and time will be saved. This study aims to assess the laboratory request forms and reports in general public hospitals in Khartoum state, Sudan.* ***Materials and methods****: In this descriptive cross-sectional hospital-based study, a checklist adapted from the WHO laboratory stepwise implementation tool was used to collect data from a random sample of hospitals attendance. Descriptive analysis was conducted using SPSS for Window version 20.* ***Results****: Out of 576 request forms assessed none was completely filled with all parameters, the average completion was 35.71%; the only parameter which was filled in 3 hospitals was the patient's name. Very important information that allows accurate reporting and interpretation of test results were missed, the doctor's name was shown in 28.6%, other parameters like sex, age, department, and the diagnosis with a completion rate of less than 24%. Also, out of 576 reports studied none was completely filled with all parameters, the average completion was 52.06%. Parameters were completely filled in 3 hospitals were name of the hospital, test name, and test result. This was followed by the patient's name (99.3) patient identification number (96.5%), date of release of the report (80.6%), Laboratory staff member name (53.3%), and presence of reference value range was shown in 45.3%, filling of other important parameters was poor.* ***Conclusion****: This study shows that the standard of completion of the request and report forms at our study sites was very poor. To improve proper filling of request and report practice, continuous medical education programs must be conducted and a well-established policy better to be developed.*

Keywords— *Completion, laboratory, laboratory errors, reports, request forms.*

I. INTRODUCTION

Laboratory services are an important component of all health systems. Laboratory tests which are reliable and well-timed are basic for the efficient treatment of patients (1). In the past, laboratory quality was assessed by the accuracy of the analytical phase in the laboratory total testing process. Following the improvement of quality of this phase via development in analytical techniques, better training of staff, better rules for detecting the errors early in internal quality control programs, and more effective external quality assessment, the analytical error is become not the main reason for the error (2) (3). Current evidence revealed that the pre-and post-analytical steps of the total testing process are more prone to error than the analytical phase (4).

Recently, there is an increasing interest in quality improvement and patient safety activities in health care. Laboratories are now asking to widen their focus to go beyond analytical quality. Accreditation agencies are increasingly requiring laboratories to consider and take responsibility for the pre-and post-analytical (or extra-analytical) phases where most errors occur (5).

The Joint Commission International set the International Patient Safety Goals; the purpose of these Goals is to improve patient safety. The first goal is to Identify patients correctly: by using at least two ways to identify patients. For example, use the patient's name and sex. The second one is to Improve effective staff communication by reporting critical results of diagnostic tests and getting important test results to the right staff person on time, thus these two goals emphasizing the initial and final steps of the testing process (6) (7).

Proper filling of all the information needed on the laboratory forms will assist diagnosis, hence patient care will be improved and resources and time will be saved.

On the other hand, inadequate, incorrect, or illegible data on laboratory request forms and reports can delay the communication of important results, such as life-threatening results, Furthermore, despite good lab practices requiring that all critical results must be communicated to the treating physician to facilitate quick and proper action, Unfortunately, there is a lack in writing doctor name or department most of the time, a previous study conducted in Australia by Burnett et al. has shown that 43% of request forms lacked complete information based on a request form audit, The specific items of information that missed included the requesting doctor's name (8). Sometimes, there was a misidentification of both the patient and the requested test.

Audit of laboratory request forms will give important information that will help both clinical laboratory personnel and doctors in improving the quality of laboratory results. Also, close contact between doctors and laboratory personnel will impact positively patient care. Finally leading to improve quality of services (9).

Collection and handling of laboratory results is a vital phase of the clinical laboratory testing process, especially critical results. Results that not reach the ordering doctor

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affect the quality of patient care and leading to waste of resources (10).

There is limited published or documented study in Sudan. This study aims to assess the quality of laboratory request forms and reports in general public hospitals in Khartoum state, Sudan. The study is expected to fill the gap to improve the quality of care provided to the patient and patient safety strengthening.

II. Materials and Methods

A descriptive, cross-sectional, hospital-based study was carried out in three general public hospitals in Khartoum State (Omdurman, Bahri, and Ibrahim Malik teaching hospitals). The three hospitals were selected based on the presence of laboratory which consisting of all laboratory departments which are hematology, chemistry, microbiology, and histopathology. All hospitals have different outpatient and inpatient departments working in collaboration with the medical laboratory department.

All laboratory request and report forms from the laboratory in the selected hospitals, including hematology, microbiology, chemical, and histopathology request and report forms were manually scrutinized for the presence of parameters provided in Box 1 and 2

Box 1 parameters examined on laboratory request forms

Lab ID number
Patient's name
Sex
Age
Date of birth
Phone number
Department/Unit
Doctor's name
Doctor signature
Clinical diagnosis
Treatment information
Date of Request
Type of sample
Date of sample collection
Time of sample collection
Legibility of handwriting

Box 2 parameters examined on laboratory result reports

Name of hospital
Patient's name
Sex
Age
Name of requesting doctor
Sample type
Date of request
Date of sample collection
Test name
Test Unit
Test result
Presence of reference value range
Laboratory staff member name
Date of release of the report
Time of release of the report
Lab ID

The sample size was calculated using the formula $n = z^2 p q/d2)$ to be 576 for each request and report forms

A systematic random sampling technique was used (The average of request forms was 3135 requests), to calculate the sampling interval (576/3135 = 1/5).

The first request included in the sample was chosen randomly then every fifth request was included in the sample. The same method was applied for the result report.

Data was collected using a structured checklist which modified from the WHO laboratory quality stepwise implementation tool (11) (12).

Data was checked before entry, monitored by the researcher throughout the analysis phase. The entered data was analyzed using the SPSS software version 20. Descriptive statistics were used and data was displayed as frequency tables and Graphs.

Ethical approval for the study was issued by "The Ethics Review Board in Sudan Medical Specialization Board" and then from "The Ethical Committee in Khartoum State Ministry of Health". As the study aims to assess the request and report forms at the time of data collection, Permission to access request and report forms and "written informed consent from the laboratory technicians present in the laboratory at the time of the assessment" was obtained. Informed consent was not obtained from patients as the study was interested in the completeness of request and report forms not in the details of patient information (i.e., The study interested to see whether the age or sex was written in the request form rather than what was stated as age or sex for patients) after consideration and approval of the above ethics committees. Furthermore, permission from each hospital authority was obtained. The data collected for this research will not be used for any other purposes.

III. Results

All hospitals under the study had no standard forms for requesting laboratory tests, i.e., they depend on handwritten paper in requesting a test. But had a result form for some laboratory departments.

Laboratory request forms:

A total of 576 request forms studied. The results obtained are shown in Table 1 and Figure 1.

Out of a total of 576 request forms studied, none was completely filled with all parameters.

The only parameter which was filled in 3 hospitals was the patient's name. This was followed by patient identification number (96.4%), legibility of handwriting (83.5%), doctor signature (54.9%), type of sample was filled in 45.0% of request forms, and doctor's name was shown in 28.6%. Filling of other important parameters like sex, age, department, and the diagnosis was extremely poor with a completion rate of less than 24%. While the drug therapy was not filled at all.

Overall, the average of the completion of the items in the request forms in the 3 hospitals was 35.71% which was considered poor. Highest average was noted in Omdurman hospital which was 40.66%, while the lowest one showed in Bahri hospital was 33.09%

Laboratory result reports:

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A total of 576 result reports studied. The results obtained are shown in Table 2 and Figure 2.

TABLE 1. Information required on laboratory request forms and their frequency and percentage of completion in 3 general public hospitals, in Khartoum state, Sudan, 2016, (n=576)

Items expected on request form	Hospital							
	Ibrahim Malik (N=192)		Bahri (N=192)		Omdurman (N=192)		Total (N=576)	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Lab ID number	173	90.1%	190	99.0%	192	100.0%	555	96.4%
Patient's name	192	100.0%	192	100.0%	192	100.0%	576	100.0%
Sex	0	0.0%	14	7.3%	0	0.0%	14	2.4%
Age	7	3.6%	44	22.9%	34	17.7%	85	14.8%
Date of birth	13	6.8%	0	0.0%	1	.5%	14	2.4%
Phone number	2	1.0%	0	0.0%	4	2.1%	6	1.0%
Department/Unit	72	37.5%	23	12.0%	18	9.4%	113	19.6%
Doctor's name	61	31.8%	60	31.3%	44	22.9%	165	28.6%
Doctor signature	57	29.7%	83	43.2%	176	91.7%	316	54.9%
Clinical diagnosis	96	50.0%	20	10.4%	19	9.9%	135	23.4%
Treatment information	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Date of Request	49	25.5%	45	23.4%	123	64.1%	217	37.7%
Type of sample	48	25.0%	68	35.4%	143	74.9%	259	45.0%
Date of sample collection	20	10.4%	34	17.7%	52	27.1%	106	18.4%
Time of sample collection	14	7.3%	7	3.6%	22	11.5%	43	7.5%
Legibility of handwriting	158	82.3%	173	90.1%	150	78.1%	481	83.5%
Average of completion	33.40%		33.09%		40.66%		35.71%	

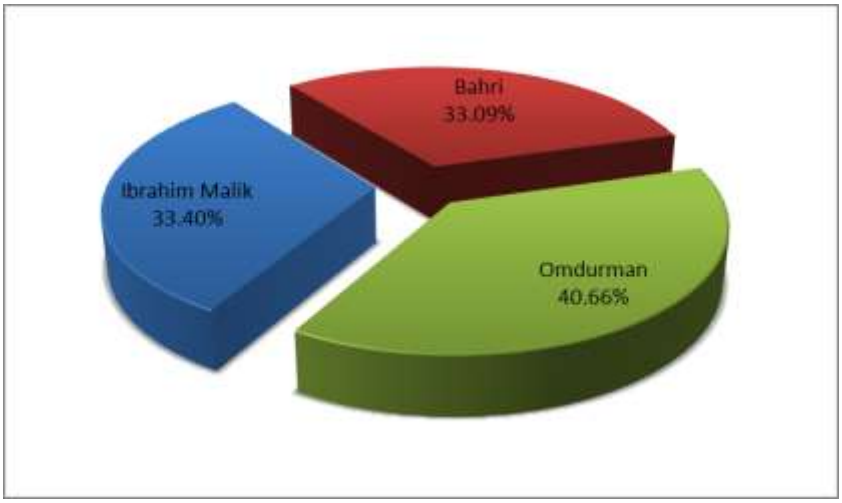

Figure 1. Average of completion of the items in the request forms in 3 general public hospitals, in Khartoum state, Sudan, 2016, (n=576)

TABLE 2. Information required on laboratory result reports and their frequency and percentage of completion in 3 general public hospitals, in Khartoum state, Sudan, 2016, (n=576)

Items expected on the report form	Hospital							
	Ibrahim Malik (N=192)		Bahri (N=192)		Omdurman (N=192)		Total (N=576)	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Name of hospital	192	100.0%	192	100.0%	192	100.0%	576	100.0%
Patient's name	190	99.0%	192	100.0%	190	99.0%	572	99.3%
Sex	0	0.0%	25	13.0%	13	6.8%	38	6.6%
Age	0	0.0%	28	14.6%	10	5.2%	38	6.6%
Name of requesting doctor	1	.5%	29	15.1%	52	27.1%	82	14.2%
Sample type	2	1.0%	62	32.3%	192	100.0%	256	44.4%
Date of request	16	8.3%	2	1.0%	62	32.3%	80	13.9%
Date of sample collection	8	4.2%	2	1.0%	62	32.3%	72	12.5%
Test name	192	100.0%	192	100.0%	192	100.0%	576	100.0%
Test Unit	71	37.0%	165	85.9%	14	7.3%	250	43.4%
Test result	192	100.0%	192	100.0%	192	100.0%	576	100.0%
Presence of reference value range	90	46.9%	50	26.0%	121	63.0%	261	45.3%
Laboratory staff member name	127	66.1%	154	80.2%	26	13.5%	307	53.3%
Date of release of the report	91	47.4%	181	94.3%	192	100.0%	464	80.6%
Time of release of the report	66	34.4%	28	14.6%	0	0.0%	94	16.3%
Lab ID	181	94.3%	187	97.4%	188	97.9%	556	96.5%
Average of completion	46.19%		54.72%		55.27%		52.06%	

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Out of a total of 576 report forms studied, none was completely filled with all parameters.

Parameters were completely filled in 3 hospitals were name of the hospital, test name, and test result. This followed by patient's name (99.3%), patient identification number (96.5%), date of release of the report (80.6%), Laboratory staff member name (53.3%), Presence of reference value range was shown in 45.3%, Sample type (44.4%), and test Unit (43.4%), other parameters constitute less than 20%.

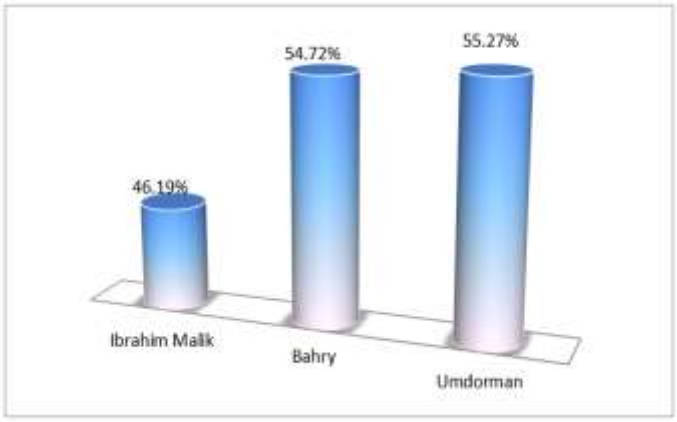

Figure 2. Average of completion of the items in the report forms in 3 general public hospitals, in Khartoum state, Sudan, 2016, (n=576)

Overall, the average of the completion of the items in the report forms in the 3 hospitals was 52.06%. Highest average was noted in Omdurman hospital which was 55.27%, while the lowest one showed in Ibrahim Malik hospital was 46.19%.

IV. DISCUSSION

Recently, a lot of evidence collected showed that quality in clinical laboratories was not expected just by focusing on the analytical part only. Pre and post-analytical processes are also important for ensuring quality laboratory services. Current evidence stated that laboratory errors more occur in the pre and post-analytic phase, influencing patient care and outcome (2).

Request forms are essential to delivering accurate messages from a clinician to the laboratory services. So, An appropriate filling of the request form improves the efficiency in services and reduces the chances of pre-analytical errors, whereas, lack of adequate information in the request form has a bad impact on interpretative reporting, and delays proper communication between the requesting clinician and the laboratory which may lead to serious consequences (13) (14) (15)

In this study, the three hospitals under the study were lacking prepared, uniform and standardized request forms, they depending on the handwritten white paper in the requesting of laboratory test, however, they had a report form for some laboratory department. As well, there was no perfect system and a negative attitude toward the complete filling of request and report forms.

Scrutinizing to the request forms was done to check for completion of patient personal, clinical information as well as requesting doctor details, and check for legibility of handwriting. The results revealed that the average completion rate to the standard was very poor, with a percentage of 35.71% in all hospitals.

Out of a total of 576 request forms studied in 3 hospitals (192 request forms for each hospital), none was completely filled with all parameters required, this is compared with a similar study conducted in Rio de Janeiro, Brazil in which 100% of the request forms studied revealed one or more gaps in the completion of the items assessed (16).

The only parameter that was completely filled in 3 hospitals was the Patient's name; with a 100.0% completion rate, this is similar to that obtained by studies which showed that the patient's name was stated on all the request forms they assessed (9) (17) (18) (19), this high percentage of a name may be due to the fact that if the name of the patient is missing on the request form it is rejected and the request is excluded and not processed further. Then patient identification number constitutes 96.4%. This is similar to the study in South Africa in which 0.3% of request forms had no hospital identification numbers (20), Although this high percentage of patient identification number written in the scrutinized forms, but this small gap considered as an area for serious errors because the labeling and further processing of the sample and reporting of the results in the hospitals under study depend on the patient identification number, so when missed and if associated with missed other identifier it may leading to the overlapping of the results and minimal harm in this situation is the repetition of test which leads to waste of resources and time of both patient and lab technician.

Filling of other important parameters like sex, age, department and diagnosis were extremely poor with a completion rate of less than 24%.

In this study, Sex and age were filled in 2.4%, 14.8% respectively; this result was highly different from the result of 86% and 94.2% obtained from a study done in Pakistan (21), and highly different from the study conducted in North India in which age was mentioned in 98.6%, sex of patients was mentioned in 98.7% (22). Age and sex of patient are extremely essential as the reference ranges for several tests are age and sex-dependent, also they help in specimen identification and proper interpretation of results, In cases where samples from different patients have the same names, information such as the age and sex are important in identifying and sorting out both the patients and samples.

Department or unit in the hospital was found just in 19.6%, the similar study by Adamu *et al* found information regarding the department of the patient was missing in 24% (23), the presence of department of the patient is necessary for locating the patient who may need a repeat of sample collection and enables critical results to be immediately reported to the clinician as fast as possible. As well as writing doctor's information, is important to communicate critical result immediately and it proofs accountability when necessary. In this study doctor's name was written in 28.6%, while the

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signature was written in 54.9% of the form, this result is highly different from a similar study conducted in Rio de Janeiro, Brazil. In which, requesting physician name was provided in 98%, and signature of the physician in 99.5% (24).

In the current study, clinical diagnosis was found only in 23.4%, This is lower than the result of a study conducted in northern India the diagnosis was mentioned in 38.8% (22), and more than the result of a study by Younas *et al* in which clinical information was endorsed in 9.7 % of request forms, presence of clinical diagnosis can affect the correct interpretation of the result (25), it helps the laboratory personnel to focus on some vital test and therefore, it saves time and resource. In this study type of sample filled in 45.0% of request forms, in comparison with the study in northern India, is slightly high in which the type of the specimen was mentioned in 38.4% forms (22). Our result highly different from a study conducted in Nigeria which was not stated in 2.7% of forms assessed, and also different from a study in South Africa indicated that the type of specimen collected was not stated only in 11% of forms (20). The nature of the sample helps to prevent identification errors during processing, In the absence of information regarding the type of sample collected, some tests

like bloody cerebrospinal fluid can easily be misunderstood as blood sample by the laboratory staff, resulting in the use of inappropriate diagnostic technique, reference ranges, and ultimately misleading results.

The date of the request was provided in 37.7% of the forms. This is highly different from a study conducted in Lagos, Nigeria in which the requested date was provided in 88.2% (26), This may not be relevant to the examination or reporting but becomes necessary when turn-around time is being considered or if complaints about delays in reporting found.

The date and time of sample collection were provided in 18.4% and 7.5% of request forms respectively, Which is highly different from the study conducted in South Africa indicated that 3.3% and 15.3% did not state the date and time of sample collection respectively (20). The time of specimen collection is important in therapeutic drug monitoring. The reference values for certain analyses also differ according to the time of day, Moreover, the time of collection is crucial for many samples like CSF which its result is much affected by the delay. Missing the time of collection may change the outcome of the whole process and may result in inaccurate patient results, so it has an impact on proper diagnosis and delivery of quality service.

In this study the drug therapy was not filled at all, the percentage was 0.0%, This is lower than the result of a study in South Africa in which the drug details found in 10.4% of request form only (20), Many drugs can affect the interpretation of results and some may even interfere with tests. From this study legibility of handwriting in the request form was 83.5%, this is to some extent slightly lower than the study in South Africa in which 4% of all forms were illegible. No doubt legibility of handwriting and clarity of the request form is very important in the identification of requested test and other important information that leading correct interpretation of the result.

Scrutinizing to the report forms was also done to check for completion of patient personal, clinical information as well as lab technician's details, the result of the current study revealed that: Out of a total of 576 report forms studied (192 reports for each hospital), none was completely filled with all parameters, with the average completion of 52.06%.

Parameters were completely filled in the three hospitals where the name of the hospital, test name, and test result, with 100.0% completion rate. Although the patient's name should be filled in 100%, actually it filled in 99.3%, this may be due to the attention of the laboratories in the hospitals under study going to patient identification number given by the lab at the time of registration and before sample collection, but this is maybe considered as an area for error. Even more, the patient identification number constitutes 96.5%, this is also may lead to error and inaccuracy of interpretation which may affect patient safety and overall outcome. Then the date of release of the report present at 80.6%.

Laboratory staff member name represents 53.3%, Which is different from the study conducted in Rio de Janeiro, Brazil that states signature of the laboratory staff member who prepared the report was found to be 99.5% (24), the importance of the presence of name or signature of the laboratory staff member is mainly in the accountability and quality as those are the focus of current concern in laboratory medicine.

The presence of reference value range just found in 45.3% which needs more attention and should consider in all report forms, especially for hematological, chemical and serological results to avoid misleading results, as most patients in the emergency departments were seen by junior doctors, who had not enough experience to dealing with the interpretation of all results. Sample type was seen in 44.4%, Test Unit in 43.4%, other parameters constitute less than 20%.

All these may affect clinical decisions and management of patients and will impact negatively on the patient's outcome.

V. CONCLUSION

In conclusion, this study proves that processing incomplete laboratory request forms can lead to difficulty inappropriate interpretation of results and generation of the report with poor quality; these may affect clinical decisions and management of patients and will impact negatively on the patient's outcome

To deal with this problem, We recommend that developing a well-established policy regarding filling of request and report practice, also there is a need to develop standardized, well-prepared request forms, that facilitate the proper filling of important information in a time-efficient manner. The best way to improve the quality of data provided with each request would be to introduce electronic requesting. On the other hand, medical students and newly employed house officers mandatory to be oriented about how to properly complete information in the request form, as well as informed about the importance of providing all relevant information to the laboratories and the impact when some data missed.

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Declarations

Ethics approval

Ethical approval for the study was issued by "The Ethics Review Board in Sudan Medical Specialization Board" and then from "The Ethical Committee in Khartoum State Ministry of Health". Permission to access request and report forms and "written informed consent was obtained. Furthermore, permission from each hospital authority was obtained. The data collected for this research will not be used for any other purposes.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

"SA is the main author of the paper and contributed to the design of the study, the analysis and interpretation of data, and was a major contributor in writing the manuscript. EM was a supervisor and contributed to the revision of the manuscript. Both authors read and approved the final manuscript."

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