

The Effectiveness of Clinician Education on the Adequate Completion of Laboratory Test Request Forms at a Tertiary Hospital

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Abstract

Background: Inadequately completed laboratory test request forms contribute to preanalytical errors and limit the advice of pathologists when interpreting laboratory test results. Educating clinicians about this has been proposed by several studies as a strategy to reduce the occurrence. **Aim:** We aimed to determine the effectiveness of such education on the prevalence of adequately completed laboratory test request forms. **Subjects and Methods:** This was a quasi-experimental study conducted at the chemical pathology laboratory of the Lagos University Teaching Hospital, Nigeria. Incoming laboratory request forms were audited for a period of 1 month looking out for eight data variables. Subsequently, intensive clinician education was undertaken via seminars, publications, and orientation programs on 670 clinicians for 6 weeks duration. After that, a repeat audit for the same data variables was conducted for another period of 1 month. A Z-test of significance for the comparison of independent proportions was conducted for form errors pre- and post-intervention. **Results:** Error rates for missing variables pre- and post-clinician education were: Name pre = 0 (0%), post = 0 (0%); age pre = 330 (21.6%), post = 28 (1.9%), $P < 0.001$; gender pre = 64 (4.2%), post = 53 (3.6%), $P = 0.37$; hospital number pre = 848 (55.6%), post = 524 (35.3%), $P < 0.001$; clinician name pre = 165 (10.8%), post = 64 (4.3%), $P < 0.001$; ward/clinic pre = 311 (20.4%), post = 235 (15.8%), $P < 0.01$; clinical diagnosis pre = 220 (14.4%), post = 33 (2.2%), $P < 0.001$; specimen type pre = 169 (11.1%), post = 116 (7.8%), $P < 0.01$, respectively. **Conclusion:** There was an improvement in the inadequate completion of laboratory request forms after clinicians were educated on proper completion using various interactive media, showing that it is an effective strategy. However, further studies are required to identify which educational strategy is most effective in reducing error rates in laboratory test request forms.

Keywords: Clinician education, Laboratory audit, Laboratory quality, Laboratory test request forms, Preanalytical errors

Introduction

The laboratory test request form is the first contact between the patient and the laboratory, on which pathologists require information to make their input in the patient's management.^[1]

Some errors in interpretative comments have been attributed to insufficient, and/or illegible clinical information provided on laboratory request forms which may result in comments

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that are misleading or harmful to patients.^[2,3] Consequently, inadequately completed laboratory request forms limit pathologists' advice to clinicians and may contribute to medical error.^[4] Although laboratory services may constitute only 5% of a hospital's budget, it contributes 60–70% of critical decision-making such as hospital admittance, medication administered, length of hospital stay, and discharge.^[5] Consequently, the previous paradigm on hospital revenue generation has shifted to a concern for higher quality at a lower cost of healthcare. Therefore, it is crucial that each health institution examine its total testing process in the form of audits to discover lapses and propose appropriate corrective action.^[6]

The majority of laboratory errors occur in the preanalytical phase of laboratory workflow,^[7-10] and inadequately completed forms have been described as a contributory preanalytical error.^[11,12]

These preanalytical errors can impact on patient care. A study by Carraro *et al.* which identified 12-tests with errors in request procedures (7.5%) described delay in treatment 57.6% (57/99), and inappropriate therapy 19.2% (19/99) as patient outcomes, stating that 91.9% of their preanalytical errors were preventable.^[13] In addition, a South African study that looked at the impact of laboratory nonconformances on patient care also observed inadequacies in patient care in 22% (56/255) cases.^[14]

Several studies have demonstrated errors of inadequately completed laboratory forms in their settings,^[4,15-18] and have proposed recommendations such as: Educating clinicians to complete laboratory request forms appropriately,^[4,16,19] conducting orientation programs for medical personnel including visits to the laboratory to see how it functions,^[15] auditing of test request forms when presented to the laboratory,^[11] and fostering a closer interaction between the laboratory and the requesting clinicians.^[15] Despite this, only a few studies have been conducted to assess the effectiveness of these recommendations. Based on this, the aim of this study was to determine the effectiveness of clinician education on the prevalence of adequately completed laboratory forms at a Nigerian tertiary hospital by examining the error rates pre- and post-educational intervention.

Subjects and Methods

Study design

This was a quasi-experimental study (one group pre- and post-test within-participant design)^[20] conducted at the chemical pathology laboratory of the Lagos University Teaching Hospital (LUTH), which is a 600-bed multidisciplinary academic tertiary hospital in South-West Nigeria. A single pretest observation of data variables from a group of laboratory request forms was performed, and then intervention occurred. Thereafter a single posttest observation on the same data variables was taken on the same group^[20] Ethical clearance

for this study was obtained from the LUTH health research and ethics committee; and there was confidentiality of data observed.

Participants

There are 850 clinicians in various specialties of medicine at LUTH, who are responsible for the completion of laboratory forms for test requests. Of this, 670 clinicians participated in the educational programs.

Method

An audit of the laboratory request forms from in- and out-patients was conducted on receipt in the laboratory to assess the completion of eight data variables (name, age, gender, hospital number, clinician name, ward/clinic, clinical diagnosis, and specimen type) daily for a period of 1 month. All laboratory request forms received in the chemical pathology laboratory, irrespective of the test requested, were included in this study.

Intervention

After that, clinicians in the hospital were educated on the importance of each variable on the lab form via: Seminar presentations at general and departmental meetings by chemical pathologists, direct communication via distribution of information, education and communication pamphlets, and publication in the clinicians' magazine; over a period of 6 weeks. An orientation program was also organized for house-officers, which included a visit to the laboratory.

One month after the conclusion of the educational campaign, a repeat audit of new, incoming laboratory test request forms for the same variables was performed for another period of 1 month. The laboratory forms were not altered in any way between pre- and post-intervention. The total duration of the study was 5 months.

Sample size determination

Using the formula $n = (z^2pq)/d^2$, where n = sample size, z = critical value at 95% confidence level, usually set at 1.96, p = prevalence, $q = 1-p$, d = precision of 5% (0.05).^[21]

Prevalence of 43% was used as Burnett *et al.* showed that 43% of lab request forms lacked complete information.^[22]

Inputting variables in formula, $n = (1.962 \times 0.43 \times 0.57)/0.052 = 376.6$.

We therefore aimed to collect data which was more than this calculated sample size, and we did.

Statistics

Microsoft Excel version 2010 (Microsoft Inc., USA) was used to analyze the data obtained. Error rates were determined as missing data variables divided by the total number of laboratory test request forms reviewed and expressed in

Table 1: Comparison of error rates of inadequately completed laboratory test request forms pre- and post-clinician education

Laboratory test request form variable	Error rates		Z-score	P
	Preclinician education	Postclinician education		
	(number of lab forms=1526) n (%)	(number of lab forms=1485) n (%)		
Name	0	0	– ^a	NS
Age	330 (21.6)	28 (1.9)	16.7	<0.001*
Gender	64 (4.2)	53 (3.6)	0.9	0.37
Hospital number	848 (55.6)	524 (35.3)	11.2	<0.001*
Clinician name	165 (10.8)	64 (4.3)	6.7	<0.001*
Ward/clinic	311 (20.4)	235 (15.8)	3.2	<0.01*
Clinical diagnosis	220 (14.4)	33 (2.2)	12.1	<0.001*
Specimen type	169 (11.1)	116 (7.8)	3.1	<0.01*

^aUnable to compute, *Statistical significance was determined at $P < 0.05$. NS: Nonsignificant

percentages. Comparison of the two independent proportions pre- and post-intervention was performed by Z-test using SPSS version 20 (Chicago, IL, USA), and the level of statistical significance was established at $P < 0.05$.

Results

Before the implementation of the clinician educational programs, 1526 forms requesting for 7990 laboratory tests were reviewed, whereas post clinician education, 1485 forms requesting 7680 laboratory tests were audited. The error rates with associated significance are shown in Table 1.

All error proportions were significantly reduced post intervention (with the exception of name which remained unchanged at zero errors). This was especially noted for age, clinical diagnosis, and clinician's name.

Although individual proportions both pre- and post-intervention were significantly reduced, hospital number and ward/clinic errors were consistently higher than the other form variables.

Discussion

The international standard for medical laboratories with a particular requirement for quality and competence developed by the International Organization for Standardization states that the laboratory test request form should contain sufficient information to identify the patient, the authorized requester, as well as provide pertinent clinical data (item-5.4.1).^[23]

The eight data variables chosen in this study were chosen from the list given in the standard document as:^[23] name of patient, unique identification of patient (which was our hospital number), identification of attending physician (clinician name), destination for the report (which was our ward/clinic), the type of primary sample, relevant clinical information, gender, and date of birth (age). These variables are required for every laboratory

test request irrespective of the test being ordered, of which the last four variables are crucial for interpretative purposes. The quality standard also mandates that the laboratory provides instructions for the completion of request forms (item-5.4.3 c),^[23] which supported the basis for our educational campaign.

The error rate of absent age on laboratory test request forms in this study preintervention was 21.6% which was comparable to Olayemi and Asiamah-Broni^[15] who described 25.6%. We observed that some of our laboratory request forms used the designation of "Ad" to refer to adults instead of stating their actual age. Clinicians were informed on the importance of age to determine the appropriate reference interval for proper test result interpretation.

Likewise, gender is important on the laboratory request forms to enable the Pathologist use appropriate gender-specific reference intervals when interpreting certain test results, for example, fertility hormones. Our study recorded a gender error rate of 4.2% preintervention, which was higher than Adegoke *et al.* 0.2%^[11] but lower than Olayemi and Asiamah-Broni^[15] and Siddiqui^[17] that reported 32.7% and 95%, respectively. Our results dropped to 3.6% after the information dissemination.

Olayemi and Asiamah-Broni^[15] noted that 75.7% of laboratory request forms had clinician's signature whereas 55.4% indicated their actual names. In our study, the error rate of no clinician name given was 10.8%, but dropped to 4.3% after clinicians were educated on the need to identify attending doctors in cases where there may be the need to contact them for clarification of their patient's condition when equivocal test results are generated, or for the delivery of critical results. Our improved error rate falls within the optimum performance level of <5% of request forms without physician information, proposed by the International Federation of Clinical Chemistry and Laboratory Medicine (IFCC) working group on "laboratory errors and patient safety."^[24]

Similarly, information about the ward/clinic tells the laboratory where the request is originating from and is a means of locating the patient and the attending clinician, to deliver a test result; which can be life-saving in the case of critical results.^[25] Our study recorded an error rate of no ward/clinic stated of 20.4% preintervention which was higher than 0.3% reported by Adegoke *et al.*^[11] but lower than 47.8% by Olayemi and Asiamah-Broni.^[15] Our rate reduced to 15.8% postintervention.

The lack of relevant clinical diagnosis was described as 19.1% by Nutt *et al.*^[25] and 20.8% by Zemlin *et al.*,^[4] respectively. Our study showed a reduction of 14.4% to 2.2% error rates, pre- and post-intervention, respectively because clinicians were informed that the clinical diagnosis helps to put the laboratory findings in the right perspective, and query assay failures when deviations occur. Clinicians were required to state the current status of the patient's clinical condition (without abbreviations) with emphasis on any form of recent medical intervention.

Our greatest error rate was with the hospital number which was 55.6% before clinician education. This was higher than 4.4% reported by Adegoke *et al.*^[11] but lower than 81% reported by Siddiqui.^[17] After explaining to clinicians that hospital numbers uniquely identified a patient, as first names and surnames can be duplicated and/or similar, we recorded a drop in this error rates to 35.3% postintervention. Despite this, it was consistently higher than other form variables. This may be because the laboratory ascribes a unique identification number to each test form received. Nonetheless, the hospital number is important and should be emphasized during future training.

The preintervention specimen type error rate recorded in this study was 11.1% compared to 3.3% reported by Zemlin *et al.*^[4] Clinicians were informed on the variation in analyte concentration in different specimen types, for example, creatinine levels in plasma and urine differ by 1000 fold. Our postintervention error rate for specimen type was 7.8%.

Like other studies,^[4,11,15,17] our study showed 100% completion with patient's name. This may be because it is the most obvious identification of the patient. Furthermore, most laboratories reject test request forms without patient name at the point of reception.

In general, our study recorded improvement in error rates when the postintervention audit of the laboratory request forms was carried out 1 month after the educational programs. This is contrary to findings by Romero *et al.* that assessed the role of training activities in reducing preanalytical errors by clinical nurses in primary care. They observed an increase in error rates of the postintervention audit ($n = 1172, P < 0.001$) which was conducted 4 months after the educational programs, although they did not study laboratory request forms.^[26] This increase was attributed to a prominent rise in hemolyzed samples in comparison to other errors with reduced or unchanged error rates.^[26]

In developed countries, the advent of technology in the laboratory has provided electronic laboratory test requesting which has greatly limited the errors seen in inadequately completed laboratory requests and has proven to be a more sustainable approach,^[27,28] especially since test requesting may not proceed if certain data variables are omitted. Unfortunately this is unavailable in LUTH, nor in most public laboratories in other developing countries. Some of which were reviewed for comparison in this study.

Limitations

Due to lack of random selection, lack of a control group, and lack of error rates specific to educational intervention, we have concerns for internal validity and are unable to ascribe causality. Consequently, this research is considered as a pilot study with promising results, which was limited by institutional constraints and available resources. We intend to expand this research work by categorizing clinicians according to education intervention and evaluating the error rates received from the groups of clinicians pre- and post-test on each of the

6 educational interventions, as well as perform a two sample *t*-test of educated versus non-educated controls. This will enable us to determine causality for error rate change, rather than the possibility for more compliant clinicians entering the system prior to the posttest. This way we would be able to identify which educational intervention is most effective in producing the greatest reduction in error rates.

Furthermore, the impact of errors specifically from inadequately completed laboratory request forms on the outcome of patient's management was not determined in this study, similar to previous studies.^[4,11,15,17] This can greatly limit the seriousness when advocating for organizational support for the educational programs, and so needs to be assessed in our future study.

Conclusion

The education of clinicians on the significance and importance of data variables on the laboratory test request forms brought about an improvement in their compliance of adequate completion of the laboratory test request forms, but further studies are required to identify the most effective approach, which will direct health institutions' efforts to obtain maximal quality improvement. Periodic laboratory audits and continuous improvement should be conducted,^[29] to enable the realization of the proposed desirable performance levels of laboratory requests given by the IFCC working group on "laboratory errors and patient safety."^[24]

To improve clinician's compliance, it is recommended that our educational seminars be conducted quarterly during the hospital's grand-round interdepartmental meeting, as well as the establishment of statutory orientation programs for newly employed house-officer. This can comprise of presentations, demonstrations, and distribution of easy-to-read pamphlets; with an emphasis on form variables our study identified as significant for improvement such as hospital number, ward/clinic, and specimen type.

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Conflicts of interest

There are no conflicts of interest.

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