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Increased patient satisfaction and safety by following implementation of an electronic specimen collection module in phlebotomy during COVID-19 pandemic

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Abstract

Background: COVID-19 will probably last for a long time. Patient's satisfaction and safety are the need of the hour and of the most important quality indicators in the laboratory medicine. Patient satisfaction in outpatient phlebotomy settings typically depends on wait time and venipuncture experience, and many patients equate their experiences with their overall satisfaction with the hospital. spreading patients in time and place so that safety during blood sampling is guaranteed. Aim: To assess the patient's satisfaction and safety with phlebotomy services in Clinical Laboratory Medicine Administration (PCLMA) at King Fahad Medical City by a structured questionnaire with grading scale. Also, identify the problems causing dissatisfactions and to undertake necessary Corrective and Preventative Action (CAPA). Materials and Methods: We compared patient service times and pre-analytical errors pre- and post-implementation of an integrated electronic health record (EHR)–laboratory information system (LIS) and electronic specimen collection module. We also measured patient wait time and assessed patient satisfaction using a 5-question survey. Switching from a written survey to an electronic one to be convenient with Covid 19 preventive measures. Results: The percentage of patients waiting less than 10 minutes increased from 89% pre-implementation to 98% post-implementation of the EHR-LIS ($P \leq .001$). The median total service time decreased significantly, from 7 minutes (IQR, 5-9 minutes), to 3 minutes (IQR, 1-4 minutes) ($P = .005$). The pre-analytical errors decreased significantly, from 3.20 to 1.93 errors per 1000 specimens ($P \leq .001$). Overall patient satisfaction improved, with an increase in excellent responses for all 5 questions ($P \leq .001$). Conclusions: Even though the overall patient's satisfaction was high, we found several benefits of implementing an electronic specimen collection module, including decreased wait and service times, improved patient satisfaction, and a reduction in pre-analytical errors. few recommendations were made such as adoption of barcode system and Hospital Information System (HIS) patient feedback survey

Keywords: electronic health record, laboratory information system, wait time, pre-analytical errors, patient satisfaction, positive

patient identification, Corrective and preventive action, Phlebotomy, Structured questionnaire.

*** Introduction**

Regular healthcare has come to an abrupt standstill because of the SARS CoV-2 pandemic. As in some countries the enormous pressure of COVID-19 on critical care nowadays seems to diminish, regular care should be taken up again [1]. As a consequence, clinical laboratory testing and blood sampling is increasing [2]. Safe phlebotomy activities on a large scale, however, cannot be done without additional measures. Triage of symptomatic COVID-19 patients and non-symptomatic patients is not enough, since a large proportion of infectious patients are asymptomatic.[18,19]

The quality standards laid down by National Accreditation Board for Hospitals and Healthcare Providers (NABH) have also emphasized the patient's role in the improvement of laboratory services [16,17]. NABH has identified some important key indicators which include waiting time for phlebotomy service to monitor the management, process and outcome especially patient satisfaction, which are used as tools for continual improvement.

Patient satisfaction refers to how the patient feels about the service he or she received in proportion to what they expected. A phlebotomist may be the first person a patient encounter. Before punctures, the patient should be made relaxed. This can only be achieved if phlebotomists are respectful.[3]

Pre-analytical mistakes, such as unlabeled or mislabeled tubes, can have a negative impact on patient care and may need a second venipuncture. [9,10,11] Several studies have shown that electronic positive patient identification (PPID) systems or specimen collecting modules can reduce pre-analytical mistakes in the outpatient context.[12,13] For non-phlebotomy collections, Le et al[13] built a unique specimen collecting module and discovered a substantial reduction in mislabeled, unlabeled, incorrect specimen received, and no specimen received problems. Another study indicated that using a PPID system greatly reduced the number of mislabeled specimens, a high-risk pre-analytical mistake in inpatient settings.[14]

It is now a global trend in health-care development toward integrating

subjective user satisfaction into the evaluation of medical service quality.[4] Medical care aims not only to improve health status but also to respond to the patient needs and wishes and to ensure their satisfaction with care.[5] Patient satisfaction surveys are helpful in monitoring hospital's quality of care with various services offered and also serves as a significant quality indicator.6

The main challenge lies in spreading patients in time and place so that safety during blood sampling is guaranteed in accordance with infection prevention guidelines. Here we describe a number of measures based on best practices and recommendations, keeping this in view, we examined the effects of implementing an interfaced electronic health record (EHR)–laboratory information system (LIS) and electronic specimen collection module on patient wait and service times, patient satisfaction, and pre-analytical errors in an outpatient phlebotomy setting. We hypothesized that the combination of an interfaced EHR-LIS and electronic specimen collection module would lead to lower wait and service times, improved patient satisfaction, and a reduced rate of pre-analytical errors. the present study was carried at Pathology and Clinical Laboratory Medicine Administration (PCLMA) services at King Fahad Medical City in Kingdom of Saudi Arabia.

*** Materials and Methods**

A cross-sectional study design was utilized to determine the levels of satisfaction experienced by patients.

*** Study Site**

This study was performed at Pathology and Clinical Laboratory Medicine Administration (PCLMA), King Fahad Medical City, Second Central Healthcare Cluster (C2) , Riyadh, KSA. In February 2021, the laboratory transitioned from an in-house developed, custom LIS to a new vendor LIS. In June 2021, we implemented a new EHR, Epic (Epic Systems, Inc.). The EHR has a bidirectional interface (orders and results) with the LIS. Both inpatients and outpatients are serviced by the clinical laboratory using the Epic system. The majority of specimens (>90%) in the outpatient setting are collected by phlebotomists. There are 6 outpatient phlebotomy draw laboratories one in each floor in addition to the main central laboratory that receive 600-800 patients per day

performing approximately 260,000 venipunctures annually.

*** Outpatient Phlebotomy Workflow Description**

*** Pre–EHR-LIS Implementation**

Before the execution of the EHR, research facility tests in the short term setting were requested by providers and interpreted onto paper demand structures. The patient would show up at a phlebotomy site with a paper order structure, check in, and furnish a type of ID alongside the demand structure. The phlebotomist would then physically increase the order(s) into the short term LIS and print example marks, which contained data about the tests requested, number of tubes, and tubes types to draw. At the point when prepared, the phlebotomist would bring in and verbally distinguish the patient against data gave on the paper demand and example names, and afterward perform the venipuncture. When the examples showed up in the research center, the examples were reaccessioned into the in-house created LIS and relabeled.

*** Post–EHR-LIS Implementation at Sites with a Specimen Collection Module**

Post-implementation, laboratory tests are requested electronically in the HER (Epic system) and sent electronically to the LIS (Beaker Epic system), eliminating the majority of paper requisitions. Concurrent with the implementation of the EHR, 5 out of the 7 outpatient phlebotomy sites, including the main one, also implemented PQS queuing system. Patients arrive at a phlebotomy site for specimen collection and enter his/her Medical Record Number (MRN) on PQS queuing system then a ticket will be generated. The phlebotomist will check the PQS queuing system then calls in the patient, verbally identifies the patient. The phlebotomist then calls in the patient, verbally, and the phlebotomist performs the venipuncture. The phlebotomist will enter MRN of the patient then, the test orders and information on which tubes to draw then display on the patient's chart in Beaker Epic System. A barcode-readable label prints from the zebra printer on the phlebotomy station, and the phlebotomist performs the venipuncture. The specimens are labeled beside the patient, sent to the processing area, and scanned into the LIS with no additional reaccessioning or relabeling required.[15]

*** Inpatient Phlebotomy Workflow Description**

*** Pre–EHR-LIS Inpatient specimen collection sites Implementation**

Inpatient labels are printed by the unit nurse within 5 min before every routine blood collection round. Each patient has separate labels (patient room number were written on each separated barcode). After taking the collection labels from the unite wards, the phlebotomist will then proceed with the blood collection procedure. Inpatient Senior phlebotomist will divide the work according to number of patient and give the assignment. After collection, all specimens should be labeled in front of the patient and given to the nurses on the unit station.

*** Post–EHR-LIS Implementation at Inpatient specimen collection sites**

In inpatient set, the phlebotomist opens Epic rover Application (Epic Rover is a mobile app from Epic Systems that allows clinicians to record documentation and conduct barcode validation at the point of care, typically the patient bedside.

As an extension to workstation-based barcoding, Rover facilitates barcoded medication administration (BCMA), using a device-mounted scanner to ensure positive identification of patient, medication, and clinician.

Available for iOS, Android and other mobile platforms, Rover connects in real time to Epic's central data repository, providing access to other information held in the Epic system, like patient lists and charts Rover allows nurses and phlebotomists to complete specimen collection workflows on a handheld device with an up-to the-minute draw list, barcode scanning for positive patient and specimen identification, label printing, and quick specimen collection documentation.) on his/her mobile device, to access to the Epic system, like patient lists and charts (Inpatient Senior phlebotomist will divide the work according to number of patient and give the assignment , the phlebotomist will have his own patient list in his/her rover application ,then from that list he/she will accept the assignment and or send it to the nurse or other phlebotomist)

To open a patient's chart from a patient list using Rover, an individual would simply tap the patient's name or use the device scanner to scan the patient's wristband. The test orders and information on which tubes to

draw then display on the mobile device-rover App. A LIS-readable label prints from the mobile printer beside the patient, and the phlebotomist performs the venipuncture. The specimens are labeled beside the patient, sent to the processing area, and scanned into the LIS with no additional reaccessioning or relabeling required.[15]

*** Patient Wait Time**

Patient wait time was defined as the interval from patient arrival to the phlebotomist calling in the patient for the venipuncture. Both pre- and post-EHR implementation wait times were manually recorded at each outpatient site. The patients entered their name and arrival time on a log sheet at check-in, and phlebotomists entered the time they called in each patient. A clock was stationed next to the log sheet to improve ease of use and accuracy. Pre-implementation, patient wait times were recorded for 6 months since February2021. Post implementation, patient wait times were recorded for 6 months since July 2021 till February 2022. We calculated the percentage of patients waiting less than 10 (average 7 Min) minutes pre- and post-implementation, with the goal of 90% of patients waiting less than 10 minutes.

*** Phlebotomy Service Time**

Phlebotomy service times were collected pre- and post-implementation of the EHR-LIS at the 7 outpatient sites referenced earlier in this article. *Service time* was defined as the total amount of time the phlebotomist spent to ensure a successful venipuncture, including the time spent accessioning/releasing the orders from the EHR and performing the venipuncture. *Patient draw time* was defined as the time from when the patient was called in to the time the patient exited the laboratory. A research assistant observed and manually recorded the accessioning time and draw time. The median and interquartile range (IQR) for accessioning, draw, and total service time (accessioning time + draw time) was calculated.

*** Pre-analytical Errors**

Pre-analytical errors are monitored closely and may be identified by phlebotomists, central laboratory staff, or clinicians. All errors are documented in the LIS. The volume of each of the top 4 pre-analytical errors (mislabeled, unlabeled, no specimen received and

wrong specimen received) was obtained from an automated LIS report for the months of February 2021 through July 2021, pre-implementation, and August 2021 through February 2022, post-implementation. To determine the number of pre-analytical errors in the outpatient phlebotomy department, the reports were filtered by ordering site to include only outpatient sites where patients are sent to the phlebotomy department for specimen collection. Using the filtered data, we also determined the total specimen volume collected by the outpatient phlebotomy department and used that volume to normalize the error rates per 1000 specimens collected pre- and post-implementation. Similarly, to determine the effect of implementing the specimen collection module, we compared the number of errors per 1000 specimens at sites using the specimen collection module to sites who did not use the specimen collection module.

*** Patient Satisfaction Surveys**

Patient satisfaction was assessed pre-implementation (n = 504 at 2021) and post-implementation (n = 417 at 2022) in our highest volume outpatient laboratory using a 6-question survey in the form of the following questions:-

1- Did you consider your waiting time reasonable?
2- Did the phlebotomist ask you about your complete name and explain the procedure to you in understanding manner?
3- Did the phlebotomist perform the blood collection procedure with easer and with just a single prick?
4- Was the staff professional and courteous?
5- Would you rate this blood collection service as convenient (location and working hours)?

Patients were instructed to respond to the questions on a percentage scale (100% -Strongly agree, 80% -Agree, 60%- Disagree, 40%- Strongly disagree). The percentage of excellent responses was calculated for each question, and pre- and post-implementation percentages were compared.

We commenced the survey in form of written papers for the first 3 months, then switched it to be electronic keeping the same format by scanning a given code, we found the electronic mode was more safe, reduced crowdedness of patients and duration of their presence inside the phlebotomy sites and saved supplies and papers.

*** Statistical Analysis**

A Fisher exact test was performed to compare the percentage of patients waiting less than 10 minutes, pre-analytical errors, and patient satisfaction pre- and post-implementation. A Mann-Whitney statistical test with treatment for ties was performed to compare service times pre- and post-implementation. *P*-values of .05 or less were considered statistically significant.

*** Result**

*** Patient Wait Time**

Prior to the implementation of the integrated EHR-LIS, only 86% of patients were waiting less than 10 minutes, increasing significantly to 93% (P ≤.001) post-implementation.

*** Phlebotomy Service Time**

Pre-implementation, the median total service time was 7 minutes (IQR, 5 to 9 minutes), decreasing significantly to 3 minutes (IQR, 2-5 minutes) (P = .005) post-implementation. Similarly, the median accessioning time dropped significantly, from 2 minutes (IQR, 1-3 minutes) pre-implementation to 1 minute (IQR, 1 to 2 minutes) post-implementation ($P \leq .001$). The median draw time did not change significantly pre-implementation (4 minutes; IQR, 2-5 minutes) and post-implementation (3 minutes; IQR, 3-5 minutes) (P = .76).

*** Pre-analytical Errors**

The total number of the top 4 pre-analytical errors decreased significantly, from 3.20 per 1000 specimens pre-implementation to 1.93 per 1000 specimens post-implementation ($P \leq .001$) (Table 1). There was a significant decrease in mislabeled, unlabeled, and no specimen received errors (P = .0004, P = .001, and P = .000001, respectively), with no mislabeled or unlabeled specimens post implementation (Table 1). However, there was no change in the wrong specimen received errors (Table 1) (P = .81).

Table 1. Pre-analytical Errors in the Outpatient Phlebotomy Department Pre- and Post–EHR-LIS Implementation

Error Type	Errors Per 1000 Specimens Pre-HER-LIS	Errors Per 1000 Specimens Post-HER-LIS
Mislabeled	0.12	0.00*
Unlabeled	0.15	0.00*
No specimen received	2.61	1.56*
Wrong specimen received	0.32	0.34
Total	**3.20**	**1.93***

* Significant decrease compared with values pre-HER-LIS implementation (*P*-value ≤ 0.05).

EHRK, electronic health record; LIS, laboratory information system.

*** Specimen Collection Module Vs No Specimen Collection Module**

At larger phlebotomy sites using the specimen collection module, the total of the top 4 pre-analytical errors decreased significantly, from 3.07 per 1000 specimens to 1.61 per 1000 specimens following implementation (P ≤.001) (Table 2). Similarly, mislabeled, unlabeled, and no specimen received errors all decreased significantly (P = .004, P = .01, and P = .000003, respectively). In contrast, the decrease in errors at sites not utilizing the specimen collection module was not significant (Table 2).

Table 2. Effects of a Specimen Collection Module on Pre-Analytical Errors

Error Type	Specimen Collection Module Sites - Errors Per 1000 Specimens		Non-Specimen Collection Module Sites - Errors Per 1000 Specimens	
	Pre-	Post-	Pre-	Post-
Mislabeled	0.12	0.00*	0.12	0.00
Unlabeled	0.16	0.00*	0.15	0.00
No specimen received	2.52	1.37*	2.85	2.32
Wrong specimen received	0.29	0.24	0.39	0.63
Total	3.07	1.61*	3.51	2.95

* Significant decrease compared with values pre-HER-LIS implementation (*P*-value ≤ 0.05).

EHRK, electronic health record; LIS, laboratory information system.

*** Patient Satisfaction Surveys**

Overall patient satisfaction improved post-implementation, with a significant increase in excellent responses across all 6 questions (P ≤.001) (Figure 3). The satisfaction with the length of wait time increased, from 89% to 98% (P ≤.001) (Figure 3).

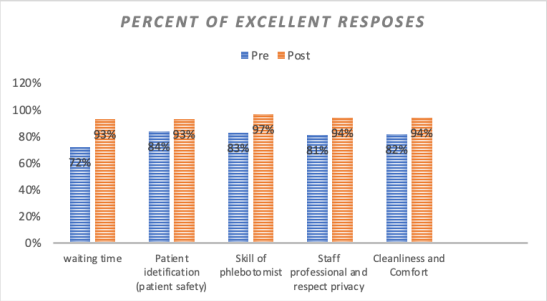

Figure 3 Patient satisfaction survey results pre- and post-implementation of an electronic health record (EHR)–laboratory information system (LIS). Percentage of patients giving the response *excellent* to 5 different questions is depicted pre-implementation (dark gray bars) and post-implementation (light gray bars). * indicates significant increase compared to pre-implementation values.

*** Discussion**

We had hypothesized that patient wait times would improve with an interfaced EHR-LIS due to the

reduction in paper requisitions and manual processing. Furthermore, standing orders were less time consuming as phlebotomists did not have to search for the requisition and manually track the order expiration date. Indeed, we were able to meet our post-implementation goal of more than 90% of patients waiting less than 10 minutes. The wait time metric is an important indicator of performance; however, it is time consuming to manually collect these data. We are presently implementing electronic tracking of patient wait times at all 7 phlebotomy sites

A similar study done by Koh YR et al., found that patients were most dissatisfied by the explanation of the phlebotomy procedure given by doctor, nurses and phlebotomist. However, in our study patients. For certain key parameters such as waiting time and adequate manpower for phlebotomy services, few previous studies were done to optimize waiting time and manpower effectively. Jeon BR et al., did a study on reducing waiting time period in phlebotomy services by adopting active-phlebotomist phlebotomy system, in which a phlebotomist went to patients actively instead of patients going to phlebotomists 7. A study done by Mihajlovic AS et al., concluded that efficacy and accuracy of phlebotomy staffing could be improved in outpatient department by using a simple tool of patient waiting time, patient venipuncture volumes to derive the estimated capacity and satisfaction survey 8.

The results of our patient satisfaction surveys demonstrated improved scores for all 5 categories included in the questionnaire. Some specific comments included “very much improved,” “have never had such an easy and quick stick,” and “phlebotomists were very friendly and courteous and very efficient.” Several factors likely contributed to the increased level of satisfaction reported. The EHR obviated the need for patients to return to their provider to fix illegible orders or to add missing information, leading to shorter wait time. The improvement in cleanliness and comfort may be explained by renovations that had occurred shortly before implementation of the EHR-LIS. The ability of phlebotomists to answer questions more effectively and respect for privacy could be attributed to the availability of orders in the EHR. The use of electronic devices may have

been perceived as an increase in the skill of the phlebotomist. We are currently expanding our surveys to all outpatient sites, to monitor patient satisfaction on a comprehensive and ongoing basis.

Similar to our previous findings in inpatient setting,[20] the interfaced EHR-LIS and specimen collection module significantly decreases the number of outpatient pre-analytical errors. The number of unlabeled and mislabeled specimens was 0 post-implementation, likely due to the specimen collection module and the correct number of specimen labels printing at the bedside and displaying collection information. The modest reduction in no specimen received errors can also be attributed to this same fact. In contrast, there was no reduction in the number of wrong specimen received errors post-implementation, even though information on the tube type was readily available to the phlebotomist. Our investigation into these individual errors revealed that they were frequently due to the erroneous release of orders from EHR not intended for the phlebotomy department (eg, requests for bodily fluids or stool, orders from other hospitals). To remedy this problem, we recently introduced a yellow caution sign to prompt the phlebotomist not to release an inappropriate order, along with a green symbol to flag the appropriate orders that should be released. Errors also occurred when multiple laboratory tests were ordered and the patient had a specimen drawn immediately after releasing the orders. In these cases, there was insufficient time for all the orders to be transmitted to the specimen collection module. As a result, the phlebotomist did not see all the orders on the specimen collection module, leading to a no-specimen or wrong specimen received error. We are working to increase the data transmittal speed of the server, in order to improve this process. In addition, we also plan to use wristbands with ambulatory patients and eliminate the face sheet, to further decrease errors.

*** Limitations**

Small sample size and the questionnaire did not include certain parameters such as availability and cleanliness of toilet, it was performed at a single center in a specific geographic region; therefore, our results may not be applicable to other types of centers or regions as the

systems vary considerably between hospitals. To express the number of pre-analytical errors per 1000 specimens, we filtered the data by ordering sources, focusing on locations that send their patients to the outpatient phlebotomy department.

*** Conclusion**

In conclusion, we found that an integrated EHR-LIS, along with an electronic specimen collection module, improved the workflow and accuracy in the outpatient phlebotomy department. Our pre-analytical error rates fell markedly, we met our goal of 90% of our patients waiting less than 10 minutes, and patient satisfaction increased. Other institutions should consider implementation of similar systems. few recommendations were made such as adoption of barcode system and Hospital Information System (HIS) patient feedback survey.

*** Abbreviations**

PPID

positive patient identification

EHR

electronic health record

LIS

laboratory information system

IQR

interquartile range

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