

## Research Article

# Laboratory errors among nurses at Yasuj Shahid Beheshti hospital in 2016

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## ABSTRACT

**Purpose**-The majority of medical diagnoses and treatments were made utilizing laboratory findings.Laboratory errors can be inflicted damages and extra charges to patients. The present study was conducted in 2016 to determine laboratory errors among nurses working at YasujShahidBeheshti hospital, south of Iran.

**Design/methodology/approach** –This is a descriptive, cross-sectional study that sampling method was completed by interview and the target population was all the 161 nurses working at YasujShahidBeheshti hospital. The data collecting tool was a researcher-made questionnaire which included the demographic characteristics of nurses and investigated nurses' laboratory errors in 12 questions. Data were analyzed by SPSS software using Kolmogorov–Smirnov, Mann–Whitney, Kruskal–Wallistests and *Pearson's* correlation coefficient (*r*) for finding the correlation between errors and management methods. The level of significance was set at  $p < 0.05$ .

**Findings** –83.23% of the studied nurses made at least one laboratory error in this six-month period. Taking insufficient quantity of specimen had the highest frequency (206 cases) while wrong interpretation of the test results to patient or the patient's caregiver was the least frequent error (19cases). The rates of errors had significant relationship with age, married status and kind of employment.

## Conclusion:

Although some of the recorded errors had no impact on lab results and they were reviewed only to assess the nurses' performance according to medical standards, the study findings revealed a high percentage of pre-analytical errors. It is recommended that providing training courses, hospital officials should provide a safe environment so that nurses can report their errors honestly. In this way, managers are able to manage the consequences of such errors correctly and in time.

**Keywords** -Nursing Errors, Laboratory Error, Management, Patient Safety.

## INTRODUCTION

Medical errors are among the topics that have received a great deal of attention from many experts and authorities(Jiao, 2010, Zyoud and Abdullah, 2016). Medical error can be defined as an unplanned or unintentional act that happens due to negligence or lack of knowledge which may harm the patient(Mahon et al.,

2009). Like any other profession, errors can happen in medical professions(Darabi et al., 2009)and these types of errors endangerpatient safety which is one of the fundamental objectives of health care system(Stetina et al., 2005).Despite significant improvements in health care systems, these errors are accounted

for thousands of deaths and injuries in addition to the fact that they increase costs of treatment (Kazemian and Farshidrad, 2006). In different countries, these errors are responsible for thousands of deaths, injuries and a remarkable increase in the cost of treatment (Valentin et al., 2009). Each year in America, 15000 people die from AIDS, 42000 of breast cancer, 43,000 because of car accidents but up to 98000 hospital patients die from medical errors (Mewshaw et al., 2006, Fry and Dacey, 2007). Based on some evidence like a surge in the number of law suits and formal complaints filed against nurses and doctors, the rates of medical errors are also high in developed (Mohammad Nejad et al., 2010). Among medical errors, nursing errors have the highest occurrence rates because of nurses' extensive contacts with patients (Borhani et al., 2010, Jolaei et al., 2010). Working in health care system bears different kinds of physical and mental stresses which lead to job burnout (Habibzade et al., 2010, Hekmat Afshar et al., 2013) and nursing errors among nurses. And all of these can affect the quality of care and performance of nurses (Mojoyinola, 2008). As the ultimate ideal of nursing profession is delivery of quality cares to the patient based on the highest standards, nothing is in direct opposition to this ideal more than nursing errors. Therefore, following nursing principles and making proper medical decisions are essential (Jolaei et al., 2010, Borhani et al., 2009, Sanjari et al., 2008). The incidences of errors like medication error, report writing error, procedure and performance error, ethical error and pre-analytical laboratory error are possible at different areas of activity of a nurse but laboratory error suffers undue neglect. There are three main types of laboratory errors including pre-analytical, analytical, and post-analytical errors and pre-analytical errors committed mostly by nurses at hospitals (Smith Jr, 2012, Zeighami et al., 2016). Despite significant improvement in the services of pre-analytical phase, evidence suggests the high rates of laboratory errors especially pre-analytical

errors. Also, this phase is the main source of error incidence and accounts for 80 percent of laboratory errors (Plebani et al., 2014, Melkie et al., 2014). Pre-analytical laboratory errors happen at three phases. The first phase of error is before specimen collection and includes taking specimen without doctor's order, Specimen collection from the wrong patient, inappropriate specimen container. The second phase of error includes taking excessive or insufficient quantity of specimen, hemolysis of specimen, Failure to observe sterilization technique in specimen collection, failure to collect specimen in time, harming patient and finally poor quality of specimen, and the third phase includes errors related to failure to label the specimen, wrong labeling, and failure to send the specimen in time (Plebani et al., 2014, Melkie et al., 2014, Lowe et al., 2008, Grecu et al., 2014, Wiwanitkit, 2001, Upreti et al., 2013). Error in this phase can lead to incorrect results which in turn affects patient safety (Leandro et al., 2006). Clinical decisions about a patient rely on lab results in more than 60 to 70 percent of cases and because of this, improvement of clinical laboratory services is essential (Llopis et al., 2011, Harrison and McDowell, 2008). Quality and reliability of lab results can be achieved not only by controlling analysis phase but also one should examine pre-analytical phase in clinical wards (Wiwanitkit, 2001). It's evident that management of errors and the proper handling of them would reduce the number and complications of errors. In fact, management of clinical errors requires identification of errors, controlling them and ensuring patient safety (Wachter, 2008, Sandars and Cook, 2009). Due to this, management of errors in hospital is essential to guarantee patient safety (Zarezade et al., 2013). Upon committing errors, nurses can either take the errors for granted or can manage errors by reporting them or consulting with colleagues, doctors or authorities (Manjoghi et al., 2012).

One way to manage error is to report them and the authorities should provide proper environment for reporting error so that there would be no consequences for nurses (Mohammad Nejad et al., 2010, Anoosheh et al., 2008). In a study titled "Nurses' Attitudes and Practices Regarding Error Reporting", Kaldjian et al. stated that nurses would like to report 97 percent of errors leading to minor injuries and 93 percent of errors leading to major injuries (Kaldjian et al., 2007). In some studies, based on the condition of study and the definition of error, the percentage of error reporting oscillates between 24-94 percent (Fein et al., 2005).

Laboratory findings are the key to most diagnoses and treatments and any type of error can have serious consequences like injury, prolonged hospitalization, and the increase in treatment cost. The first step in the prevention of error is the study of type of error, its frequency and nurses' attitude towards error (Wachter, 2008, Sandars and Cook, 2009). Due to significant lack of literature and reliable statistics regarding nurses' laboratory errors in Iran, the present study has been done to examine nurses' laboratory errors.

## **METHODS**

This cross-sectional, descriptive study was performed at Yasuj Shahid Beheshti Hospital. The sampling method was complete enumeration that included all the nurses with ASN, BSN, and MSN degrees working at clinical wards. Out of 182 qualified nurses, 161 nurses (88.46) participated in the study and others either did not participate in the study or failed to fill the questionnaire properly, therefore, they were excluded from the study (11.54). The inclusion criteria were holding associate, B.S., or M.S. degrees, having at least a six-month working experience as a nurse in hospital wards and willingness to participate in the study and the only exclusion criterion was incomplete filling of questionnaire. This study observe all the ethical principles such as necessary correspondence with responsible officials

and units, introduction of the program and acquiring staff's consent with strict emphasis on ensuring nurses regarding the confidentiality of information, voluntarily participation and anonymity of participants. As an example of the study's restrictions, this study was developed based on staff's self-reporting and it seemed that samples were not cooperative enough. So, researcher ensured them about confidentiality of information and anonymity without the need to mention their names and surnames. Also, nurses handed their filled questionnaires to a reliable mediator without having to meet the researcher face-to-face. It can be said that nurses' level of participation and their honest reporting of errors were a proof that researcher managed to win their trust. Data collecting tool was a researcher-made questionnaire consisting of six parts. The first part examined demographic information such as age, gender, academic degree, marital status, working hours, form of employment, health condition, their working ward. The second part includes 12 cases of laboratory errors and for each case, eight questions were considered. First, we have three options; " I have committed", "I haven't committed" and " number of cases" which were mainly designed for determining the type and frequency of errors with " I have committed" scored (1) and "I haven't committed" scored (0). And then for computing the total, the score of each question multiplied by the number of cases.

Then, we have five questions regarding management method of error handling which cover issues like reporting to authorities, Reporting and consulting whit colleague, or hide and inattention, taking action to rectify the situation by reporting to patient or his caregiver. Each question includes three options; " I have committed", "I haven't committed" and " number of cases" with " I have committed" scored (1) and "I haven't committed" scored (0). And then for computing the total, the score of each question multiplied by the number of cases.

It should be noted that based on the expert opinion of the five professors, after the estimation of qualitative content and face validity, quantitative content and face validity were calculated with the help of twelve experts in the field of nursing and medical ethics using Lawshe table that computed items appeared to be  $CVR = 0.71$ ,  $CVI = 0.79$ , respectively. Internal validity of the data collection tool was computed with the help of ten nurses who were excluded from the study (Cronbach's  $\alpha = 0.81$ ). Descriptive statistics, Kolmogorov-Smirnov, Mann-Whitney and Kruskal-Wallis tests and SPSS software version 16 were used to analyze the data.

## RESULTS

In this study, 161 nurses participated with an average age of  $30.02 \pm 4.87$  year-old, with working experience of  $5.63 \pm 5.01$  year and average working hour of  $181.1 \pm 21.7$ . Considering job description, (154 persons - 7.95%) were nurse and the rest were head nurses and most of their completed shifts were night shifts (60 persons 3.37%). The majority of

nurses (153 persons, 95%) say they have no other career besides nursing. Regarding mental and physical well-being, most of them claimed to be healthy ( $n = 145$  1.90%) and only 16 individuals (9.9%) acknowledged to suffer from underlying diseases.

Based on the findings of this study, 1001 cases of laboratory error were self-reported which indicates that during a six-month period, 83.23 % of the participating nurses committed laboratory errors. The average of laboratory errors was 6.22 for each nurse in a six-month period and 1.04 in a one-month period. Also, the results showed that taking insufficient quantity of specimen (206 cases or 20.58 %) and taking excessive quantity of specimen (161 cases or 16.08 %) had the highest frequency while wrong interpretation of the test results to patient or the patient's caregiver (19 cases or 1.90 %) and hurting the patient during taking specimen (20 cases or 1.99%) were the least frequent error. (Table No.1)

**Table 1.** Frequency Distribution of Different Types of Laboratory Errors among Nurses Working at Yasuj Shahid Beheshti Hospital

Types of Laboratory Errors	Number of Error(Percent)
Insufficient quantity of specimen	206 (20.58)
Excessive quantity of specimen	161(16.08)
(Failure to collect samples on time)	151 (15.10)
Wrong interpretation of the test results due to unfamiliarity with normal ranges	129 (12.89)
(Failure to send the samples to lab on time)	94 (9.39)
Taking specimen without doctor's order	74 (7.39)
Incorrect specimen collection	55 (5.49)
Failure to observe sterilization technique in specimen collection	35 (3.50)
Failure to report the test result to doctor on time	32 (3.20)
Specimen collection from the wrong patient	25 (2.49)
Phlebotomy error	20 (1.99)
wrong interpretation of the test results to patient or the patient's caregiver	19 (1.90)

Considering the results of Kolmogorov-Smirnov test in this study, laboratory error variable ( $P=0.0001$ ) and is less than the significant level of 0.05. So, this variable didn't have normal distribution so for comparing the amount of nurses' laboratory errors based on qualitative bivariate demographic characteristics, Mann-Whitney test was used and the results were presented in the Table No. 2. Based on the presented data in this table, parameters of descriptive statistics indicated that the amount of laboratory errors were higher in the nurses within the age-range of 36 year-old and higher, male nurses, married nurses, and nurses with management experience. Mann-Whitney test confirmed a significant statistical difference among laboratory errors and age group and marital status and indicated that laboratory errors

tend to be significantly higher among married nurses and nurses within the age-range of 36 year-old and higher( $P \leq 0.05$ ).

**Table 2.** Comparison of the Mean of laboratory Errors among Nurses in Terms of Binary Qualitative Variable

Demographic Characteristics	Groups and Categories	Frequency	Mean ± Standard deviation	Mean Rank	> Median	≤ Median	Mann-Whitney Test	
							Z	AsympSig. (2-tailed)
Age Group	Up to 35	140	5.61±5.30	96.76	60	80	-2.86	0.004
	36 and more	21	7.36±10.29	107.93	15	6		
Gender	Male	38	7.46±6.24	90.95	25	21	-1.72	-0.85
	Female	123	5.72±5.58	77.02	50	65		
Marital Status	Single	57	5.02±4.99	71.94	20	37	-1.84	0.05
	Married	104	5.03±6.13	85.97	55	49		
Management Experience	Have	15	7.87±6.62	93.30	9	6	-1.08	0.28
	Have not	146	6.05±5.72	79.74	66	80		

Kruskal-Wallis test was used to compare nurses' laboratory errors based on qualitative multivariate demographic characteristics and the obtained results were reported in Table No.3. Based on the data presented in this table, parameters of descriptive statistics indicated that nurses with M.A. degree, tenure nurses and emergency department nurses tended to committed more laboratory errors in comparison to others. Kruskal-Wallis test did not indicate a significant relationship between university degree and working department ( $P \leq 0.05$ ) but it indicated a significant relationship between laboratory errors and forms of employment. So, the laboratory errors was significantly higher among tenure nurses ( $P \leq 0.05$ ).

**Table 3.** Comparing the Mean of Laboratory Errors among Nurses in Terms of Nominal Qualitative Variable

Demographic Characteristics	Groups and Categories	Frequency	Mean±Standard deviation	Mean Rank	Kruskal-Wallis Test	
					df	Asymp Sig.
AcademicDegree	ASN	2	3±4.24	54.50	2	0.542
	BSN	156	6.31±5.84	81.71		
	MSN or higher	3	3.67±4.72	61.50		
Employment Status	official nurses	19	7.79±8.14	86.34	3	0.035
	Employment contract	51	7.74±5.62	92.72		
	contractual employment	36	6.25±5.31	82.97		
	Recruitment plan	55	4.49±4.99	67.00		
Wards	Casualties	33	6.85±5.86	87.12	4	0.920
	Surgical units	43	5.03±5.68	77.17		
	Intensive Cares Units	35	6.28±6.32	81.90		
	Internal Units	41	4.90±3.98	79.11		
	Operating Room	9	5.89±5.58	79.73		

Based on the obtained results of this study, from the total 1001 cases of reported laboratory errors nurses managed 329 cases of these errors (32.87%). Considering the method of management of errors, Reporting and consulting whit colleague had the highest frequency (169 cases) and reporting to patient and his care giver had the lowest frequency (9cases). (Table NO.4)

**Table 4.** Frequency Distribution of Types of Errors management methods among Nurses Working at YasujShahidBeheshti Hospital

Methods of Management	No. (Percent)
Reporting and consulting whit colleague	169 (51.37)
Reporting to superior	91 (27.65)
Taking action to rectify the situation	50 (15.20)
Hide and inattention	10 (3.04)
Reporting to the patient and his caregiver	9 (2.74)
<b>Total</b>	<b>329 (100)</b>

For examining the correlation and the existence of significant relationship between laboratory errors and methods of management, Pearson's correlation test was used and the obtained results are presented in Table No. 5. As you can see, there is a positive significant correlation between nurses' laboratory errors and methods of management ( $P < 0.001$  to  $P < 0.004$ ). It should be stated that with an increase in the number of errors, there is a corresponding increase in management methods. The highest correlation was seen between laboratory error and Reporting and consulting whit colleague ( $r = 0.585$ ) and the lowest correlation exit between laboratory error and reporting to the patient and his caregiver ( $r = 0.225$ ) and there was no correlation between laboratory error and hiding the error ( $r = 0.082$ ). (Table No. 5)

**Table 5.** Study of relationship between laboratory errors and management methods

Methods of Management	Laboratory Errors (Total No.: 1001)	
	r	p
Reporting and consulting whit colleague	0.585	0.001
Taking action to rectify the situation	0.346	0.001
Reporting to superior	0.343	0.001
Reporting to the patient and his caregiver	0.225	0.004
Hide and inattention	0.082	0.304

## DISCUSSION

The Findings showed that taking insufficient quantity of specimen had the highest frequency among other laboratory errors with 206 cases (20.58 percent). In Plebani et al. the most frequent error was hemolysis of specimen (49.72) (Plebani et al., 2014). Dawlat's study titled " Laboratory errors and patient safety" showed that 35.7% of laboratory errors is relating to the stage before the analysis (Miligy, 2015) and Stefania et al. identified 1457 errors and among them hemolysis of specimen had the highest frequency (46.4 percent) (Grecu et al., 2014). The most frequent error in Upreti et al. was misidentification in pre-analytical stage with 289 cases (0.35) (Upreti et al., 2013). Based on the obtained results, wrong interpretation of the test results to patient or the patient's caregiver was the least frequent error with 19 cases (1.90 percent). In Vivanquet et al.'s study inappropriate specimen containers was the least frequent error with 6 cases (0.57 percent) (Wiwani et al., 2001) and in Stefania et al. incorrect ordering of laboratory test was the least frequent error (0.1 percent) (Grecu et al., 2014). The least frequent error was incorrect volume of specimen with 110 cases in Lowe et al.'s study (Lowe et al., 2008). The findings of different studies showed that the incidence of laboratory error is possible at any stage and this can be ascribed to lack of knowledge regarding

related principles (Mohammad Nejad et al., 2010). So, utilizing advanced technology and training staff are among the actions that can be done to reduce laboratory errors (Ayoubian et al., 2016, Mohammedsleh and Mohammedsleh, 2015).

Based on the obtained results, there was a meaningful relationship among laboratory errors and nurse's age ( $p = 0.01$ ) and the rates of errors have increased with aging and this can be ascribed to high workload and fatigue as a result of job difficulty among nurses. Tang et al.'s study on 72 nurses showed that with aging, the rate of errors decreases which is in contrast to the findings of this study (Tang et al., 2007). Taheri et al.'s study showed no meaningful relationship between age and error and age did not play a role in nursing error (Taheri et al., 2013). Although there are different findings regarding aging and nursing errors but various factors can affect the role of age in increasing or decreasing errors. For example, if hospital plans fewer night shifts and manageable workload for an older nurse, it can reduce the rate of error or vice versa.

The rates of laboratory errors were higher in men in comparison to women. A study which was performed in affiliated hospitals with Shahid Beheshti University of Medical Sciences in 2011 showed a meaningful relationship between nursing error and gender. So, male nurses committed more errors in comparison to

female nurses (Yousefi et al., 2014) but different studies in Iran and abroad indicated that determining the status of errors based on demographic characteristics is very complicated and the rate of error based on gender is no exception to this rule.

The obtained results showed that there was a meaningful relationship between laboratory errors and marital status to the extent that the mean of errors in married nurse was higher than mean of errors in single nurses. No other similar study was found regarding meaningfulness of errors based on marital status but Taheri *et al.* (2011) in a paper titled "Associated Factors with medication errors in the pediatric and pediatric emergency departments from the view point of nurses" confirm a meaningful relationship between marital status and number of errors (Taheri et al., 2013). Studying the relationship among errors and demographic characteristics can be related to different factors but it can be concluded that single persons are less busy in comparison to married persons and this helps to them to be more focused and meticulous.

The findings showed that the mean of laboratory errors was higher or bigger in official nurses in comparison to trainee nurses and there is a meaningful relationship between laboratory errors and form of employment, so, the highest the job security is, the highest the incidence of errors. In a research project in Shahrekord Hajar Hospital, there was a meaningful relationship between form of employment and laboratory errors and the rates of errors were higher in official nurses (Matin et al., 2012) which is consistent with the findings of this study but the relationship between errors and form of employment was not meaningful in various studies like Sadat Yousefi et al.'s study (Yousefi et al., 2014) but according to the finding of this study, the feeling of job security that emanate from form of employment is effective in the incidence of errors and the nurses' meticulousness.

Based on the obtained results, although the mean of laboratory errors was higher in experienced nurses but the incidence of error based on nurses' work experience was not

statistically meaningful. In most of studies, no significant relationship between work experience and laboratory error was observed but in other studies, with an increase in work experience, the incidence of error decreased (Ito and Yamazumi, 2003, Bizhani et al., 2013) but further research is needed to shed more light on the relationship between nursing errors and work experience.

Of the total number of errors (1001 cases), 329 were managed by different management methods which means that 32.87% of error were managed but the rest (67.13) were left unmanaged. In a study by Kabirzade et al. 38.8% of the individuals under study took action to report and manage their errors while 56.1% had done nothing to rectify the situation (Kabirzadeh et al., 2011). Also Salimi et al.'s study titled "Nurses' Experiences Regarding Error Reporting Process", stated that error reporting is necessary for patient safety but the number of reported errors are way lower than the actual number of errors which indicates that nurses took no action to manage their own errors (Salimi et al., 2013). Overall, studies show that 63 to 84% of nurses fail to manage their own errors due to negative reactions of authorities and colleagues (Tang et al., 2007).

The difference in this regard can be due to lack of awareness about nursing errors or different reasons like fear of consequences of error reporting. But to maintain and promote patient safety, management of errors i.e. prevention and reduction of errors should receive special attention.

The findings of this study have shown that among nurses, the most frequent management action regarding errors was consulting with colleagues with 169 cases (51.37%) and the least frequent action was direct report to patient or his caregiver with nine cases (2.74%). Based on Salimi et al.'s study, most nurses prefer to report their errors to their supervisors (Salimi et al., 2013).

In Sanagoo et al.'s study showed that the most frequent error was medication error and the most frequent action was taking the error for granted (Sanagoo et al., 2012). In Monjoqi's study, there were two most frequent

management methods among nurses; they either reported errors to their supervisors or took the error for granted (Manjoghi et al., 2012).

Based on the findings of this study, the amount of error reporting was very lower than the actual number of errors and nurses fail to report all errors. The important point here is that hospital staff utilize different management method for errors that depend on the type of error, the type of resulted injury, hospital authorities, patient and his caregivers' reactions. In this study, the least frequent method of error reporting was reporting to patient and his family which can be ascribed to cultural atmosphere of each region.

Among different methods of error management, there were correlation between laboratory error and management methods, reporting to superior ( $P=0.001$ ), reporting to doctor ( $P=0.001$ ), hide and inattention ( $P=0.304$ ) and taking action to rectify the situation ( $P=0.004$ ) while taking action to rectify the situation and laboratory errors had the highest correlation with each other. This means that this method i.e. taking action to rectify the situation was used more than any other error management methods.

Also, there was no correlation between laboratory errors and hide and inattention. After extensive study of literature and different databases, the researcher didn't find a similar study that examines the correlation between error management method and types of error. So, for this study, he has focused on close studies. In Monjoqi et al's study, there was significant relationship between amount of errors and reporting to superior ( $P= 0.001$ ), consulting with doctor ( $P= 0.001$ ), reporting the error to the next shift ( $P= 0.01$ ), reporting to patient ( $P= 0.888$ ) and hide and inattention ( $P= 0.001$ ) (Manjoghi et al., 2012).

In Shams et al.'s study, there was a positive correlation between medication error and level of their management or in the other word, with an increase in the number of errors, the number of error reporting also increases (Shams et al., 2012). It's evident that nurses used different error management methods regarding their committed errors and among the different management methods of errors, Reporting and consulting whit colleague has the highest frequency

(51.44%) which can be explained to some extent as nurses have more trust in their colleagues and can use doctors' expert opinions to rectify the situation. The least frequent method of error management was reporting to patient and his caregivers (2.64%) which can be due to resulting injuries and complications of error in the patient and this might have followed by serious consequences for nurses and mistreatment of them by patient and his caregivers. hide and inattention

## CONCLUSION

This study has examined pre-analytical laboratory errors that took place at clinical wards. The findings shed light on the importance of pre-analytical stages and show that most of errors happen at this stage where lab is not responsible. It depends more on patient condition and preparing him or her for specimen collection. Although some of these errors might not affect the test result and the examination of them was done to evaluate nurses' performances based on nursing standards, but the obtained results confirm the high incidence of pre-analytical laboratory errors. Due to the importance of lab results in treatment process and delivery of clinical cares, this study suggests that there should be training programs regarding nursing standards and promoting level of awareness for staffs to deliver safe cares to patient. Also creating a safe environment for reporting errors is essential.

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