Original Article

Awareness of pre-analytical errors amongst healthcare workers of DHQ teaching hospital, Sahiwal, Pakistan

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Objective: To assess the knowledge and attitude about pre-analytical errors amongst healthcare workers in District head Quarter (DHQ) Teaching Hospital, Sahiwal, Pakistan.

Methodology: This questionnaire-based web survey was done at Sahiwal Medical College, Sahiwal from July to August 2020. We used 24 multiple choice-question based Questionnaire, developed as per WHO & CLSI guidelines. It was distributed among healthcare workers through whatsapp messenger and responses were recorded.

Results: The frequency of correct responses varied from 14.9% to 87%. More than 80% of respondents were aware of standard phlebotomy protocols, rejection criteria, and standard operating procedure of sampling for biochemical, hematological and arterial blood gas analysis. 65 – 79% of respondents were aware of correct vacutainers and anti-coagulants used for different tests. Poor responses, 17.1% and 14.9% were recorded for sample mixing and effect of delay in analysis respectively.

Conclusion: Healthcare workers in DHQ Teaching Hospital, Sahiwal are not fully aware about basic laboratory protocols. This unawareness can lead to generation of erroneous lab reports. Formal education and training is needed to create awareness among healthcare workers.

Keywords: Awareness, healthcare workers, phlebotomy, pre-analytical errors, sample.

INTRODUCTION

Clinical laboratory result supports clinicians to make evidence based diagnostic and clinical decisions. About 60 – 80% of finalized clinical decisions are based upon laboratory results.[1] To achieve continuous laboratory improvement, it is important to focus on all phases of patient's specimen testing i.e. pre-analytical, analytical and post-analytical. Pre-analytical phase of analysis is most prone to errors, as 68% of diagnostic errors arise in this phase.[2] It involves all procedures, starting with the formulation of the medical question, and includes patient preparation, sample collection, handling, transportation, processing, and storage until the time of analysis.[3] Phlebotomy is the most common invasive laboratory procedure utilized for diagnosis of disease.[4]

Various other factors can affect the sample constituent after collection i.e. during transportation, preparation and storage. Negative effects of such factors can be reduced by standardizing the pre-analytical process.[5,6] Phlebotomy is the act of puncturing a vein to withdraw blood and is one of the most critical part of pre-analytical phase.[7] Training of phlebotomists is a pre-analytical challenge and requires continuous educational updates as the equipment is changed or improved in the healthcare centers.[8] This study aimed to assess the awareness of pre-analytical errors, compliance to guidelines by WHO (World Health Organization) and CLSI (Clinical and Laboratory Standards Institutes)[9,10] and quality of practice of phlebotomy among doctors, nurses and paramedics of DHQTH, Sahiwal.

METHODOLOGY

This cross-sectional questionnaire-based web survey was conducted among healthcare providers of DHQTH Sahiwal after approval by Institutional Review Board of Sahiwal Medical College.

Sample size was calculated by using following formula:

$$Sample\ Size = \frac{Z1-\propto 2^2\ \mathrm{p}(1-\mathrm{p})}{d^2}$$

Z 1-α/2^2 = is standard normal variate (at 5% type 1 error ($p < 0.05$) it is 1.96. As in majority of studies *p*-value is considered significant below 0.05 hence 1.96 is used in formula. p = Expected proportion in population based on previous studies or pilot studies = 0.93 (11), d = Absolute error or precision = 0.09, Sample size = 100.

Non-probability purposive sampling technique was used. Total of 328 responses were received. Data from 315 healthcare workers was included; 13 participants who didn't give consent or partially filled form were excluded. Questionnaire was made on Microsoft forms and was distributed through Whatsapp messenger and

comprised of 24 questions. 20 multiple choice questions related to qualitative variables and 4 questions regarding demographic details. Breakup of these 20 multiple choice questions was as: patient preparation/ identification (3 MCQs), phlebotomy technique (6 MCQs), Sample labelling (2 MCQs), selection of vacutainer (5 MCQs), order of draw (1 MCQ) and sample handling, transport and potential outcomes of collection errors (3 MCQs).

Statistical Analysis: Data were analyzed on SPSS version 24. Chi-square was applied for comparisons of percentages between groups formed.

RESULTS

Out of 315 participants, 194 (61.6%) were female and 121 (38.4%) males. Majority of the participants belonged to age group 20 – 30 years (64.8%) followed by age group 30 – 40 years (26.7%). Majority of respondents were nurses (39.7%) followed by House officers (20.3%), postgraduate trainees (20%), medical officers and paramedical staff (10% each).

Two third of the respondents were aware of vacutainers and anti-coagulant used for different laboratory tests (Table 1). Poor responses (17.1% and 14.9%) were recorded for mixing of additives and decline in serum glucose level in case of delay in analysis (Table 2). Rejection criteria of sample was correctly answered by maximum no of participants (87%).

Table 1: Frequency of correct responses against questions asked about patient preparation and sample collection.

Questions Related to Pre-analytical Errors		Correct Responses						P-Value
		House Officers n = 64	Post graduate Residents n = 63	Medical Officers n = 32	Nurses n = 125	Technical Staff n = 31	Total n = 315	
Questions	**Desired Response**	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**	
Tourniquet application time	01 min	37 (11.7)	45 (14.3)	18 (5.7)	82 (26.0)	21 (6.7)	203 (64.4)	0.334
Position of tourniquet	3-4’’above puncture site	17 (5.4)	36 (11.4)	7 (2.2)	78 (24.8)	18 (5.7)	156 (49.5)	0.000
Disinfectant avoided as cleaning agent	Povidone-Iodine	20 (6.3)	37 (11.7)	16 (5.1)	56 (17.8)	16 (5.1)	145 (46)	0.003
Time for alcohol swab to dry	30 sec	25 (7.9)	37 (11.7)	12 (3.8)	65 (20.6)	16 (5.1)	155 (49.2)	0.089
Position avoided for phlebotomy	Standing	58 (18.4)	47 (14.9)	26 (8.3)	111 (35.2)	19 (6)	261 (82.9)	0.001
Labeling of vacutainers	In presence of patient, after sample collection	32 (10.2)	31 (9.8)	11 (3.5)	72 (22.9)	20 (6.3)	166 (52.7)	0.150
Identifiers for labeling	Min. 2	43 (13.7)	50 (15.9)	16 (5.1)	80 (25.4)	21 (6.7)	210 (66.7)	0.009
Sample from IV line	Avoided/affect Sodium	50 (15.9)	57 (18.1)	25 (7.9)	106 (33.7)	27 (8.6)	265 (84.1)	0.216
Repeated fist pumping affects	Potassium	27 (8.6)	39 (12.4)	18 (5.7)	60 (19)	19 (6)	163 (51.7)	0.000

Table 2: Correct responses about selection of appropriate vacutainer/anticoagulant and Sample labelling.

Questions Related to pre Analytical Errors		Correct Responses						P-Value
		House Officers n = 64	Post graduate Residents n = 63	Medical Officers n = 32	Nurses n = 125	Technical Staff n = 31	Total n = 315	
Questions	**Desired Response**	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**	
Vial for biochemistry tests	Serum/ Gel Vial	52 (16.5)	52 (16.5)	24 (7.6)	94 (29.8)	29 (9.2)	251 (79.9)	0.061
Vial for Coagulation test	Citrate Vial	50 (15.9)	49 (15.6)	15 (4.8)	65 (20.6)	27 (8.6)	206 (65.4)	0.000
Vial for hematological tests	EDTA vial	42 (13.3)	53 (16.8)	24 (7.6)	103 (32.7)	28 (8.9)	250 (79.4)	0.001
Anticoagulant for ABGs	Heparin	48 (15.2)	44 (14.2)	11 (3.5)	112 (35.6)	22 (7)	237 (75.2)	0.000
Order of draw	Culture tube, citrate tube, Serum tube, EDTA tube	29 (9.2)	46 (14.6)	18 (5.7)	62 (19.7)	19 (6)	174 (55.2)	0.001
Mixing of additive	Gently inverting 4-6time	15 (4.8)	17 (5.4)	6 (1.9)	11 (3.5)	5 (1.6)	54 (17.1)	0.000
SOPs for ABGs	Heparinized sample transported on ice slurry	47 (14.9)	50 (15.9)	26 (8.3)	119 (37.8)	23 (7.3)	265 (84.1)	0.004

Higher percentages of overall correct responses were recorded among PGRs followed by, paramedics, nurses, house officers and medical officers (Table 3). Statistically significant difference was present about selection of appropriate vial /anticoagulant for coagulation, CBC, ABGs and order of draw (p = 0.000, 0.001, 0.000, 0.001) respectively.

DISCUSSION

Pre-analytical errors affect clinical decisions and patient management. Plebani et al found that preanalytical errors were most common cause of faulty laboratory results.[12]Healthcare professionals directly involved in sample collection must have sufficient knowledge about errors arising at various steps of analysis. Pre-analytical errors were common in various departments of a tertiary care hospital in Pakistan.[11] Likewise, an Indian study came to same conclusion.[13]

When participants were questioned regarding tourniquet application time and site, higher percentages of correct response were observed in PGRs as compared to rest of the workers. Similar results were observed in another study.[11] They were aware, if phlebotomists do not wait for alcohol to dry completely for about 30 seconds, it will lead to spurious hemolysis.[14] When asked about the labelling of vials and minimum numbers of identifiers required, 52% and 66% of the subjects knew the correct response respectively. Misidentifications account for large number of errors.[15]

Selecting the correct anticoagulant is critical for many tests.[16] Two-third of the respondents were aware of vacutainers and anti-coagulant used. Paramedics were

Table 3: Correct Responses about sample handling, transport and potential outcomes of collection errors.

Questions Related to Pre-analytical Errors		Correct Responses						P-value
		House Officers n = 64	Post graduate Residents n = 63	Medical Officers n = 32	Nurses n = 125	Technical Staff n = 31	Total n = 315	
Questions	**Desired Response**	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**	**n (%)**	
Hemolysis of sample	Vigorous mixing, forceful pushing of plunger	49 (15.6)	47 (14.9)	15 (4.8)	99 (31.4)	22 (7)	232 (73.7)	0.001
Rejection of sample	Insufficient volume, inappropriate vial, clotted, hemolyzed	55 (17.5)	58 (18.4)	22 (7)	115 (36.5)	24 (7.6)	274 (87)	0.000
Parameter affected by hemolysis	Electrolytes, LFTs, PT	46 (14.6)	56 (17.8)	28 (8.9)	95 (30.2)	28 (8.9)	253 (80.3)	0.047
Rate of Decline in serum glucose	5-8% / hour	10 (3.2)	10 (3.2)	5 (1.6)	19 (6)	3 (1)	47 (14.9)	0.000

well-aware aboutit (80%). These findings are consistent with a study conducted by Kulkarni et al.[17] A study by Cornes et al showed that 76.4% of participants were unaware of this order of draw.[18] Similarly, only 11% of participants were aware of it in a survey conducted by Hepburn.[19] Poor responses (17%) were recorded about mixing of additives.

Our study demonstrated that errors in pre-analytical phase contributed significantly to total laboratory errors and this might be due to lack of education and training. Similar observations were also made by Zehra et al.[20] Another study showed better knowledge scores of doctors as compared to phlebotomists.[21] It is recommended that our health system should conduct training courses for healthcare workers to upgrade their knowledge and skills. To broadly assess the awareness of pre-analytical errors, study should be repeated on a wider scale with a large sample size.

CONCLUSION

This study shows that significant number of healthcare workers in DHQTH, Sahiwalwas not fully aware of basic protocols of pre-analytical phase. This may lead to generation of erroneous lab reports, thereby affecting the quality of laboratory results. Training and education are needed to create awareness among healthcare workers.

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