Original Article

Assessment of venous blood collection practices among medical laboratory workers in Edo State, Nigeria

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Background: Phlebotomy is a complex process requiring knowledge and skill to perform safely. This study aimed at identifying deviations from best phlebotomy practices among laboratory workers involved in venous blood draws in Edo State, Nigeria.

Methods: A total of 109 participants from public and private laboratories in Edo State, Nigeria were assessed as they performed venous draws on patients.

Results: All participants identified patients by their full names only, and did not introduce themselves to patients before initiating venous draws. Only 9 (8.2%) participants obtained patients consent before venous draws. Glove use was significantly associated with participants [medical laboratory scientists: odd ratio (OR), 14.850; 95% confidence interval (CI): 3.345, 65.916; P<0.001 and medical laboratory technicians: OR, 4.405; 95% CI: 1.347, 14.401; P=0.017] in public laboratories. However, practice of hand hygiene, use of a pair of gloves per patient, proper skin disinfection and method of disposal of used syringes were observed to be poor.

Conclusions: Marked deviations from best phlebotomy practices were observed among study participants. Phlebotomy training of laboratory workers in Edo State, Nigeria is advocated.

Keywords: Venous blood collection; practices; laboratory workers; Edo State; Nigeria

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Introduction

Following the development of high quality analytical techniques, and observed increased emphasis on analytical portion of testing process, analytical mistakes now account for a minimal percentage of error in clinical laboratory testing processes (1,2). Data shows that laboratory errors primarily occur in the pre- analytical phase, severely affecting quality of patient management (1,3). Phlebotomy falls within the realm of the pre-pre-analytical phase, which includes steps (test requesting, patient and sample identification, sample collection and sample transportation) that may neither be performed in the laboratory nor undertaken by laboratory personnel (4). It is reported to be associated with risk of injury and infection to healthcare workers and patients (5,6).

Apart from the potential risk of phlebotomy to the health of the attending health worker and patient, it is also reported to affect the quality of test specimen (5). Venous blood specimen is the most common type of specimen drawn or sent to clinical laboratories for further analysis; and is the source for a potentially numerous types of errors (7). The most well-trained testing staff, using the most sophisticated instruments, cannot produce accurate results from a poorly-collected specimen (4). A superficial

knowledge of the correct order of venous blood draws, adequate fasting time before blood collection, tourniquet application time, need for complete filling of patient data, proper method of mixing of blood specimens and use of right tubes and additives are able by themselves either singularly or collectively to strongly influence many laboratory results and thereby affect the diagnostic outcome, the follow-up or even the treatment of the patients (8).

Best practices in phlebotomy require the maintenance of policies and standards of quality care for patients and health care worker (5). This can be achieved by ensuring the availability of appropriate supplies of protective equipment, post-exposure prophylaxis, avoidance of contaminated phlebotomy equipment, appropriate competency and certification in phlebotomy, and co-operation on the part of patients (5) among others. Presently, there are no national guidelines or certification bodies/council for phlebotomy in Nigeria. Data on venous blood collection practices among healthcare workers are also evidently missing. In Nigeria as in most part of Africa, the laboratory worker is actively involved in blood draws, especially among out-patients departments of health facilities (4). Regular assessment of venous blood collection practices among laboratory workers is crucial in ensuring the reliability of test result, safety of laboratory worker and patients. Against this background, this study aimed to assess deviations from best practices in phlebotomy among medical laboratory personnel's in private and public diagnostic laboratories in Edo State, Nigeria.

Methods

Study population

This was a cross-sectional descriptive study conducted from August 2013–February 2014. A total of 109 medical laboratory workers (consisting of 42 medical laboratory scientists and 67 medical laboratory technicians) involved in venous blood collection from patients in private and public diagnostic laboratories in Nigeria were recruited for this study. In Nigeria, medical laboratory scientists occupy the highest cadre in the medical laboratory profession and typically spend 4–5 years in the university followed by an internship program. They often go on to acquire higher degrees (MSc and PhD). Medical laboratory technicians spend 2–3 years in a school of health technology and obtain a diploma. They occupy a lower cadre in the medical laboratory profession. All volunteer laboratory workers had at least 1-year post qualification working experience. A questionnaire was used to obtain information on training in phlebotomy and other necessary information prior to observation of the phlebotomy procedure. Each participant was closely observed by authors during venous blood draws from three adult patients in his/her health facility. The performance of each participant was analysed against the guidelines provided by the World Health Organization (5). All venous blood collection was for the purpose of diagnostic test.

Ethical consideration

Informed consent was obtained from all laboratory worker involved in venous draws prior to the study. Informed consent was also obtained from all patients on whom venous sampling was performed. Study approval was obtained from heads/owners of diagnostic laboratories where study was conducted. Participant's names and institutional affiliation were kept confidential.

Statistical analysis

Categorical data obtained from study participants were analyzed using logistic regression analysis with the statistical software INSTAT® (Graphpad software Inc., La Jolla, CA, USA). An association was established between two variables when an OR value ≥1.00 was obtained. Statistical significance was set at $P<0.05$.

Results

Irrespective of type and affiliation (public or private) of laboratory workers only 3 (2.8%) of participants reported to have had post qualification training on phlebotomy. All participants of study identified each patient by asking for his/her name only. All participants performed venous draws with an open system (syringe and hypodermic needle) (*Table 1*).

All participants did not introduce themselves to patients before initiating venous draws. Without regards to type and affiliation of laboratory worker, only 4 (3.7%) obtained consent from all three patients before initiating venous draws. Statistics did not show any significant difference between medical laboratory scientists and medical laboratory technicians ($P>0.05$) in public and private laboratories with respect to practice of obtaining informed consent from patients (*Table 2*).

Medical laboratory scientists and medical laboratory

Table 1 Phlebotomist training, patient identification and blood collection systems

Variables	Type of laboratory worker	Public laboratory		Private laboratory		OR	95% CI	P value
		N	Yes (%)	N	Yes (%)			
Received post qualification training in phlebotomy	Medical lab scientist	15	2 (13.3)	27	0 (0.0)	10.185	0.456, 227.50	0.122
	Medical lab technician	24	1 (4.2)	43	0 (0.0)	5.327	0.208, 135.93	0.368
Method of patient identification: identified patient by full names only	Medical lab scientist	15	15 (100.0)	27	27 (100.0)	–	–	–
	Medical lab technician	24	24 (100.0)	43	43 (100.0)	–	–	–
Type of collecting device used: syringe and needle	Medical lab scientist	24	15 (100.0)	43	27 (100.0)	–	–	–
	Medical lab technician	15	24 (100.0)	27	43 (100.0)	–	–	–

N, number of laboratory worker; lab, laboratory; OR, odd ratio; CI, confidence interval.

Table 2 Performance evaluation of medical laboratory workers involved in venous blood collection

Variables	Type of laboratory worker	Public laboratory		Private laboratory		OR	95 % CI	P value
		N	Yes (%)	N	Yes (%)			
Introduced themselves to patient prior to venous sampling	Medical lab scientist	15	0 (0.0)	27	0 (0.0)	–	–	–
	Medical lab technician	24	0 (0.0)	43	0 (0.0)	–	–	–
Obtained consent from all three patients	Medical lab scientist	15	2 (13.3)	27	1 (3.7)	4.000	0.331, 48.327	0.287
	Medical lab technician	24	0 (0.0)	43	1 (2.3)	0.578	0.023, 14761	1.000
Collected blood in an enclosed location with two chairs and a table	Medical lab scientist	15	10 (66.7)	43	5 (18.5)	8.800	2.069, 37.436	0.003
	Medical lab technician	24	11 (45.8)	27	3 (6.9)	11.282	2.721, 46.771	0.0003
Patient and phlebotomist seated during venous draws	Medical lab scientist	15	3 (20.0)	27	2 (7.4)	3.125	0.459, 21.762	0.329
	Medical lab technician	24	2 (8.3)	43	2 (4.7)	1.864	0.245, 14.158	0.614
Wore laboratory coat during venous draws	Medical lab scientist	24	5 (33.3)	43	2 (7.4)	6.259	1.036, 37.689	0.077
	Medical lab technician	15	6 (25.0)	27	0 (0.0)	30.568	1.635, 571.4	0.001
Performed hand hygiene prior to putting on gloves	Medical lab scientist	15	1 (6.7)	27	0 (0.0)	5.690	0.217. 148.815	0.357
	Medical lab technician	24	0 (0.0)	43	1 (2.3)	0.578	0.023, 14.761	1.000
Put on gloves during venous sampling	Medical lab scientist	24	11 (73.3)	27	5 (18.5)	14.850	3.345, 65.916	<0.001
	Medical lab technician	15	10 (41.6)	43	6 (13.9)	4.405	1.347, 14.401	0.017
Changed gloves between patients during venous sampling	Medical lab scientist	15	5 (33.3)	43	2 (7.4)	6.250	1.036, 37.689	0.077
	Medical lab technician	24	2 (8.3)	27	1 (2.3)	3.816	0.327, 44.506	0.290
Always allowed time for disinfectant to dry up before sampling	Medical lab scientist	15	2 (13.3)	27	7 (25.9)*	0.439	0.078, 2.455	0.451
	Medical lab technician	24	1 (4.2)	43	1 (2.3)	1.826	0.109, 30.598	1.000
Always recapped used needle with scoop technique	Medical lab scientist	15	7 (46.6)	27	3 (11.1)	7.000	1.454, 33.700	0.020
	Medical lab technician	24	5 (20.8)	43	5 (11.6)	2.000	0.515, 7.767	0.476
Always discard used syringe and needle in an enclosed sharp container	Medical lab scientist	15	9 (60.0)	27	10 (37.0)	2.550	0.698, 9.314	0.202
	Medical lab technician	24	13 (54.2)	43	20 (46.5)	1.359	0.498, 3.702	0.615

*, medical lab scientist *vs*. medical lab technician: OR, 14.700; 95% CI, 1.691–127.78; P=0.0043. N, number of laboratory worker; lab, laboratory; OR, odd ratio; CI, confidence interval.

technicians in public laboratories were observed to be significantly more likely to collect venous blood in an enclosed location than their counterparts in private laboratories [medical laboratory scientists—public *vs.* private: 66.7% *vs.* 18.5%; odd ratio (OR), 8.800; 95% confidence interval (CI): 2.069, 37.436; P=0.003; medical laboratory technicians—public *vs.* private: 45.8% *vs.* 6.9%; OR, 11.282; 95% CI: 2.721, 46.771; P=0.0003]. Only 9 (31.0%) out of the 29 laboratory workers who performed phlebotomy in an enclosed area, always sat on a chair while doing so. Medical laboratory technicians in public laboratories were significantly more likely to put on a laboratory coat during sampling procedure than their counterparts in private sector laboratories (public *vs.* private: 25% *vs.* 0%; OR, 30.568; 95% CI: 1.635, 571.4; P=0.001) (*Table 2*).

The practice of hand hygiene prior to putting on gloves did not differ significantly between medical laboratory scientists (P=0.357) and medical laboratory technicians (P=1.000) in public and private laboratories. Medical laboratory scientists and technicians in public laboratories were significantly more likely to perform venous draws wearing a pair of gloves than their respective counterparts in private laboratories (P<0.05). However, use of a pair of glove per sampling procedure did not differ significantly between medical laboratory scientists (P=0.077) and medical laboratory technicians (P=0.290) in both classes of laboratories (*Table 2*).

Less than a quarter of laboratory workers in public and private laboratories allowed sufficient time for disinfectant to dry up before initiating venipuncture. This practice did not differ significantly between medical laboratory scientists and technicians in both classes of laboratories (P>0.05). However, in private laboratories, medical laboratory scientists were observed to be significantly more likely to allow sufficient time for disinfected to dry up before initiating venous draws (medical laboratory scientist *vs.* medical laboratory technicians: 25.9% *vs.* 2.3%; OR, 14.70; 95% CI: 1.691, 127.78; P=0.0043) (*Table 2*).

All participants recapped used needles after venous draws. However, only 20 (18.3%) of all 109 participants practiced the scoop technique of re-capping needles. Medical laboratory scientists in public laboratories were significantly more likely to practice safe needle recapping, than their counterparts in private laboratories (public *vs.* private: 46.6% *vs.* 11.1%; OR, 7.000; 95% CI: 1.454, 33.700; P=0.020) (*Table 2*). No needle-stick injury was observed among participants of both classes of laboratories.

Irrespective of type and affiliation of laboratory worker, a total of 52 (47.7%) participants were observed to always discard used syringes into a leak proof sharp container immediately after venous draws. No statistically significant difference was observed in issues relating to proper discard of used needles between professionals in public laboratories and their counterparts in private one (P>0.05) (*Table 2*).

Discussion

Against this background, of the paucity of published data on practice of phlebotomy in Africa, this study aimed at assessing deviations from best practices in phlebotomy among medical laboratory personnel's in private and public diagnostic laboratories in Edo State, Nigeria. To author's knowledge, this is the first attempt at assessing venous blood collection practices among laboratory personnel in Nigeria.

In this study only 3 (2.8%) out of the 109 laboratory personnel reported to have received post qualification training on phlebotomy. All persons with training were in public diagnostic laboratories. The quality of laboratory result depends largely on appropriately collected specimen. Thus, the poor post-qualification training received by laboratory workers in this study and in particular those affiliated to private health institutions may have grave consequence for precision of results obtained and quality of health care received as a vast number of Nigerians patronize private health care practitioners. This finding underscores the need for regular training of persons involved in blood collection practices in Nigeria

The World Health Organization considers identification a priority area for improving patient safety, recommending that all healthcare organizations should develop systems for ensuring correct identification of patients (9). Accurate patient and specimen identification within the pre-analytic stage is crucial as misidentification can have numerous consequences, such as an invasive procedure being performed on the wrong patient, a result reported for the wrong patient, and missed or delayed diagnoses (10). In this study, the only identifier that was used for patients by all participants was patient's full names. It is not impossible for two patients with same names to visits a blood collection center on the same day. Therefore, reliance on patient's names only may not guarantee proper sample identification during processing in the laboratory. Identification should be done alongside other factors such as date of birth, ward or location of patient, among others. A recent Nigerian study (11) which evaluated laboratory request forms for

incomplete data, revealed Information bordering on patient's age, gender, and location in the hospital were evidently missing on many forms audited. Findings from one European study have shown poor level of compliance with best phlebotomy practices with respect to patient identification and tube labeling (12). Such trends no doubt could make proper patient identification of patients at blood collection stations difficult, and may have affected the pattern of patient identification observed in this study.

All participants in public and private laboratories were observed to always use an open system (disposable syringe and hypodermic needle) for venous blood draws. Although known to be widely available and comparatively inexpensive to other engineered blood collection devices, the use of hypodermic needle and syringe has been reported to be associated with high risk of needle stick injuries, as it often requires blood transfer into test-tube (5). When transferring blood from a syringe into a test tube, contamination of sample container with spilled blood could also occur. Since the specimen containers often pass through several laboratory and non-laboratory personnel before analysis and final disposal, soiled exteriors could pose potential blood exposure to these healthcare workers (13). However, in resource poor settings, cost is a driving factor for procurement of safety engineered devices (5). In the absence of safety engineered blood collection devices, skilled use of the needle and syringe is acceptable (5). It is therefore important for laboratory workers involved in blood collection in Nigerian laboratories to constantly acquire necessary skills for its safe use through frequent training. Compliance with recommended order of venous draws could also help in reducing risk of contamination of sample tubes and improve phlebotomist and patient safety (14).

It is mandatory that the phlebotomist prior to collection of blood makes a formal introduction of himself/herself to the patient, explain briefly the procedure to be carried out, and seek for consent to proceed (5). In this study, all participants did not formally introduce themselves before initiating venous draws and only 4 (3.7%) of them were observed to obtain verbal consent from patients. Formal introduction of self will help to earn patients trust and confidence, which could have great implication for the reputation of the laboratory and possibly rate of patronage. Informed consent has both legal and ethical implications in medicine. Performance of medical procedure without patient consent is considered as battery and assault and is punishable by law (15).

A cubicle should be provided in all out-patients departments for blood collection (5). Findings from this study revealed that Medical laboratory scientists and technicians in public laboratories were significantly more likely to perform venous draws in an enclosed cubicle than their counterparts in private laboratories. Blood collection in most private laboratories was observed to be done in an area in laboratory reception, in full view of other clients and patients. This practice definitely infringes on the patients right to privacy, and could readily affect patient`s willingness to participate in the exercise. Defects in laboratory facility design particularly among those in the private sector have previously been reported in a Nigerian study (16). In Nigeria, it is common practice for private laboratory owners to rent any store or apartment without considering laboratory design (16). This may have affected the pattern of result observed.

It is good practice that patient and phlebotomist sits in a comfortable position during venous draws (5). In this study however, less than a quarter of laboratory workers in both private and public laboratories were observed to sit on a chair while collecting blood from all three patients. Most of them were found to collect blood in standing or bending position. Such awkward positions assumed by the laboratory workers in this study, could affect the angle of penetration of needle into patient's skin, thus increasing the risk for formation of haematoma. Also, different work related awkward postures have been reported to cause musculoskeletal disorders such as back pains, neck and waist pains among healthcare workers in previous studies (17,18).

All laboratory workers should put on a laboratory coat when working with or handling infectious specimens (19). However, findings from this study showed that laboratory technicians in public laboratories were thirty times significantly more likely to wear a laboratory coat during venous sampling than their counterparts in private laboratories. The practice of wearing of laboratory coats did not differ significantly among medical laboratory scientists in both classes of laboratories. Accidental spillage of blood in laboratory practice is not uncommon. Personal protective equipment such as laboratory coats may minimize the risk of exposures to blood splashes and inoculation, during venous collection of blood, and protect laboratory worker from being infected with blood borne pathogens.

It is crucial that phlebotomists practice proper hand hygiene, wear personal protective equipment such as gloves, and decontaminate the skin before puncture (20). Regardless of type and affiliation of participants, only 2 (1.8%) of laboratory workers were observed to perform hand

hygiene prior to donning gloves. The contamination rate of tourniquets with methicillin-resistant *Staphylococcus aureus* (MRSA) has been reported to be 25% due to lack of proper hand hygiene by phlebotomists in a previous study (21). Medical laboratory scientist and technicians in public laboratories were significantly more likely to use a pair of hand gloves during sampling procedure, as compared to their colleagues in private laboratories. A Nigerian study had earlier reported very poor use of gloves in private diagnostic laboratories (16). Although a higher proportion of participants in public laboratories consistently changed gloves between patients, statistics did not show any difference with respect to type of laboratory worker in public and private laboratories. Gloves used in collecting blood from a patient may be contaminated with blood which could represent high risk of transmission of blood borne diseases to another patient during contact.

Medical laboratory scientist in private laboratories were more likely than their counterparts in public ones to allow sufficient time for disinfectant to dry up on patient skin before initiating venous draws. Lack of theoretical knowledge, work overload, and lack of time have been reported as reasons for non-adherence to constituted guidelines of operations by health-care staff (22). Reports indicate that there is an acute shortage of health care workers in public health institutions in Nigeria (23), resulting in daily work overload for many health professionals. This may explain the observed pattern of result. Interestingly however, in the private laboratories, medical laboratory scientists were observed to be significantly more likely to allow disinfectant to dry up before initiating venous draws. This could be attributable to a better knowledge of principle and benefit of disinfection among them as medical laboratory scientists are known to occupy the highest cadre of the medical laboratory profession in Nigeria. Perhaps the creation of more blood collection stations, training and recruitment of more hands will correct the generally poor skin disinfection practices observed among participants in this study.

Best phlebotomy practices recommend that needles should not be re-capped after use (5). All participants were observed to recap used needles after collection of blood from patients. Re-capping of needles has been identified as a reason for sharp injuries in as high as 33.3% of nurses in a Nigerian study (24). However, if needle re-capping must be done, the scoop technique should be employed (5). Medical laboratory scientists in public laboratories, were seven time significantly more likely (OR, 7.000; P=0.02) to re-cap used needles with one hand (scoop technique) than those in private laboratories. Teaching the one-handed, scooping recapping technique has been reported to be effective in reducing the risk of recapping-related needle-stick injuries in a previous study (25). To be able to do this effectively in clinical practice, there should be a flat surface or table in the specimen collection station. This was not available in areas where venous blood was collected in most private laboratories, making safe re-capping of needles with one hand almost impracticable. A recent Nigerian study among public and private laboratories in Nigeria showed the complete absence of biosafety officers (16), bringing to question the general biosafety consciousness level of laboratory management. Although, no needle- stick injury was observed in this study, there is need for phlebotomy education of laboratory workers and provision of well-furnished blood collection stations which can promote safe-needle recapping where necessary in Nigerian laboratories. To further reduce risk of needle stick injuries there is need for introduction of safer blood collection devices that eliminates the need for blood transfer into test-tubes.

It is important that used syringes be discarded in a leak proof sharp container with a lid (5). Although, laboratory workers in public laboratories were more likely to dispose used syringes in a leak proof sharp container than those in private laboratories, the practice did not differ significantly. Improper containment and poor disposal of biomedical wastes is a potential source of infection to health care workers, patients, and the community at large (26). It is important to note that findings from this study may not be representative of the situation in Nigeria as the study was only carried out in Edo State Nigeria. This is an observed limitation to the study.

Summarily, marked deviations from best phlebotomy practices were observed among study participants in this study, highlighting the need to scale up laboratory workers competence in the act of blood collection in Nigeria. There is an obvious need for the development of standard operating procedures from existing guidelines for venous blood draws by appropriate health managers and planners at state and national levels and dissemination of same to public and private laboratories. Frequent external quality assurance programmes should also be embarked on by the regulatory body of medical laboratory science in Nigeria, to monitor and check deviations from best practices. Furthermore, improved performance in blood collection practices can be realized by ensuring that certified phlebotomists are appointed to oversee the collection of blood in the laboratories, all persons involved in the act of venous draws

from patients are sent for specific professional training in phlebotomy on a regular basis.

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Footnote

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at http://dx.doi.org/10.21037/jlpm.2017.06.17). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by heads/owners of diagnostic laboratories where study was conducted and written informed consent was obtained from all patients.

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