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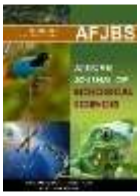

Specimen Collection Manual for Phlebotomists working as a Healthcare at Home Service Provider in India

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Abstract

Blood sample collection is an essential part of medical testing and diagnosis. It involves collection of a small amount of blood from a patient for analysis and evaluation. The research area of blood collection is a very important part of healthcare and plays an important role in the correct diagnosis and treatment of various diseases. The process of collecting a blood sample is known as phlebotomy and is usually performed by a trained professional known as a phlebotomist. They are responsible for ensuring safe and proper collection of blood samples from patients. Phlebotomists are trained in proper disposal of used needles and other equipment to prevent the spread of infections. They also follow safety procedures to protect themselves and patients from any potential hazards. Blood sample collection also includes special techniques for specific populations such as infants, children, and the elderly. The most common sites for blood sample collection are the veins in the arm, but in some cases, blood can also be collected from other sites, such as the finger, heel, or earlobe. The blood samples are collected during the period of 2021 to 2022. Descriptive and comparative analysis is performed to determine the samples collected in a year and compared with the average of two consecutive years. It ensures accuracy of medical testing in the treatment of various diseases. Phlebotomists are trained professionals who play a crucial role in this process, and their knowledge and expertise are vital in providing quality healthcare services.

Keywords: Blood collection, Phlebotomist, Collection manual, healthcare, safety, diagnostic diseases

1. Introduction

1.1 Theoretical background

Phlebotomist plays a crucial role in healthcare system by collecting blood specimens for diagnostic testing. This process requires high level of skill and attention to ensure accurate and timely results (Paul, Victoria, & Olalere, 2023). To ensure consistency and standardization in specimen collection, phlebotomists rely on a comprehensive and detailed manual. The specimen collection manual is an essential tool for phlebotomists, providing guidance on proper procedures for collecting and handling blood samples (von Meyer, Lippi, Simundic, & Cadamuro, 2020). This manual is based on a strong theoretical background, incorporating knowledge and principles from various fields of study. By practice, it is evolved and became additionally systematic and scientific approach to blood collection. Currently, phlebotomy is a crucial aspect of healthcare with phlebotomists playing a vital role in diagnosis and treatment of various medical conditions (Eric, 2023).

The primary theoretical foundations of the specimen collection manual is the understanding of human anatomy and physiology (Żytkowski et al., 2021). They must have a thorough knowledge of structure and function of the human body, particularly in circulatory system to effectively collect blood samples. They must be able to identify the correct veins for blood draw and understand the circulation of blood throughout the body (Gnidovec, Žemlja, Dolenec, & Torkar, 2020). This knowledge is essential in preventing injury to the patient and ensuring accuracy of the sample.

Critical aspect of the specimen collection manual is the understanding of infection control and prevention. Phlebotomists are constantly exposed to blood and other bodily fluids, putting them at risk of contracting and spreading infectious diseases (Omonayin, 2022). Therefore, the manual emphasizes the use of personal protective equipment (PPE), proper hand hygiene, and sharps disposal and contaminated materials (MACHARIA, 2018). This knowledge is crucial in maintaining a safe and hygienic environment for both the phlebotomist and the patient. The specimen collection manual is not just a set of guidelines for phlebotomists to follow. It is a comprehensive document that is based on strong theoretical background, encompassing knowledge from various fields of study. This manual plays a crucial role in ensuring the safety of patients, accuracy of test results, and overall quality of healthcare (Organization, 2016). Blood sample collection is a critical procedure that requires proper technique and attention to detail. This manual provides a general overview of the steps involved in collecting blood samples. However, it is important for healthcare professionals to receive proper training and follow specific protocols for their respective healthcare facilities (Lenicek Krleza, Dorotic, Grzunov, & Maradin, 2015). Figure 1 explains about the blood collection process in Healthcare.

1.2 Significance of the study

Specimen Collection Manual is a document that outlines the proper techniques and protocols for collecting various types of specimens, such as blood, urine, and saliva. It provides a comprehensive guide for phlebotomists to follow while collecting samples from patients in their homes. With a proper Specimen Collection Manual in place, phlebotomists can ensure that the same techniques and protocols are followed for sample collection, regardless of the location. This ensures standardization and consistency in the quality of samples, which is crucial for accurate test results.

Phlebotomists working as a healthcare at home service provider often deal with patients who may have limited mobility or other health conditions. The Specimen Collection Manual provides guidelines for safe and hygienic sample collection, reducing the risk of infection or injury to both the patient and the phlebotomist. Sample collection is a critical step in the diagnostic process. Improper techniques or inadequate samples can lead to inaccurate test results, which can have serious implications on a patient's treatment. By following the guidelines outlined in the Specimen Collection Manual, phlebotomists can ensure the accuracy and reliability of test results.

As the field of medicine continues to evolve, so do the guidelines for specimen collection. A Specimen Collection Manual is regularly updated to reflect any changes in techniques, safety protocols, or testing procedures. This ensures that phlebotomists are always up-to-date with the latest practices, providing the best possible care to their patients. Figure 2 illustrates about the types of blood collection tubes in Health care and hospitals.

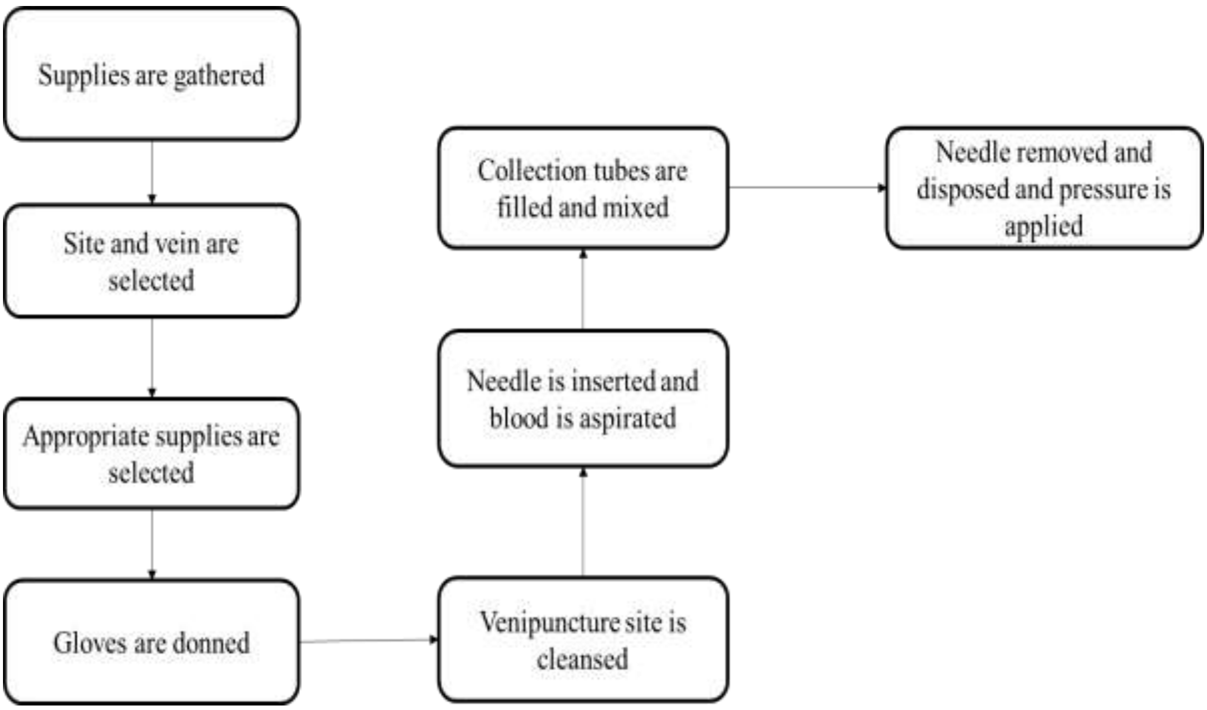

Figure 1 Flowchart of blood collection

1.3 Problem identification

In recent times, there has been notable surge in demand for healthcare at home services in India. Many patients, particularly those with chronic ailments, prefer the convenience of receiving medical care within the confines of their own homes rather than visiting a hospital. Consequently, a new role has emerged in the healthcare industry

- phlebotomists who work as healthcare at home service providers. However, the existing manual lacks a standardized procedure for collecting various types of specimens, which can cause confusion and mistakes during the collection and handling process. Moreover, the manual fails to provide sufficient information regarding the types of specimens that can be collected, appropriate collection techniques, and the proper handling and transportation of specimens. As a result, this can lead to inaccurate test results and compromise the quality of patient care. Additionally, the manual utilizes terminology that does not align with international standards, thereby making it challenging for phlebotomists to effectively communicate with other healthcare professionals and adhere to universal protocols.

Furthermore, the manual lacks comprehensive guidelines for ensuring the safety of phlebotomists while collecting specimens. This exposes them to the risk of contracting infectious diseases and other potential hazards. Unlike their counterparts in hospitals or clinics, phlebotomists working as healthcare at home service providers often receive minimal training in specimen collection. Consequently, this knowledge and skill gap can result in errors and delays in patient care.

1.4 Objectives of the study

1. To evaluate the beneficiaries of Phlebotomists in providing healthcare system at home.

2. To assess the knowledge, training and guidance of Phlebotomists in collecting blood samples.

3. To analyse the guidelines and its impact on the Phlebotomists practices in the health care systems.

4. To recommend the effective specimen collection manual for Phlebotomists to provide safety healthcare services to the patients

Tube	Color	Name	Additive	Test used for
	Blood Culture Bottle	Culture Bottle	Sodium Polyanethol sulfonate (anticoagulant) and Growth media for microorganisms	Two bottles are typically collected, in one blood draw; one for aerobic organisms and one for anaerobic organisms.
	Light Blue	Sodium Citrate	3.2% Sodium citrate (anticoagulant)	Coagulation tests
	Red	Red or plain	No additive, No Anticoagulant	Immunology, Serological examination
	Gold	Serum Separating Tube	Serum Separating Gel and clot activator	All Biochemistry test
	Light Green	Heparin Tube	Sodium heparin or Lithium heparin (anticoagulant)	prevent clotting, Chromosome testing, HLA typing, ammonia, lactate
	Purple/Lavender	EDTA	Ethylene diamine tetra acetic acid (EDTA) (Anticoagulant)	Hematological examination like complete Hemogram
	Pink		Ethylene diamine tetra acetic acid (EDTA) (Anticoagulant) Used only for Whole Blood sample being send to transfusion lab	Blood typing and cross-matching, direct Coombs test for autoimmune haemolytic anemia, HIV viral load, Group and save (G & S) These tubes are preferred for blood bank tests.
	Grey	Sodium fluoride	Sodium fluoride (glycolysis inhibitor) Potassium oxalate (anticoagulant)	Glucose, lactate testing
	Yellow	Acid-citrate-dextrose (anticoagulant)		Tissue typing, DNA studies, HIV cultures

Figure 2 Types of sample collection tubes

2. Literature review

Researchers in Ethiopia conducted a survey on phlebotomy practices at three public hospitals, evaluating 120 experts (101 Non-laboratory experts VS 19 laboratory experts) based on Clinical and Laboratory Standards Institute document. The aim of this review is to expand on previous research and current practices in other laboratories, focusing on four questionable practices during venous blood collection by healthcare professionals: i) assessing dietary restrictions; ii) cleaning the puncture site; iii) timing of tourniquet removal; and iv) mixing samples with additives. (Lima-Oliveira, Lippi, Salvagno, Picheth, & Guidi, 2015).

According to the earlier study, total medical examination and recovery need of 251 medical facilities with 51,562 beds is 474,627 of whole blood. On this basis, the clinical need in India is estimated to be 14.6 million units of whole blood, equivalent to 36.3 donations per 1,000 full population conditions, which implicates whole blood. Medical specialties represent 6.0 million units, followed by surgery 4.1 million, obstetrics and gynaecology 3.3 million and paediatrics 1.2 million units. Supply reached 93%, equivalent to 33.8 times more donations than demand (Mammen et al., 2022).

Among the 9,883 participants, 9,333 were male and 750 were female. The most prevalent blood type was B (31.68%), whereas least common was AB (11.70%). The distribution of Rh positive and negative in the study group was 93.51% and 6.49%, respectively. In males, the ABO group order was B, A, O, AB, similarly in Rh-positive individuals, while for Rh-negative individuals, the order was A, B = O, AB. For females, the ABO group order was B, O, A, AB, aligning with the Rh positive group but differing from the Rh negative group. The estimated allele frequencies were 0.2403 for IA , 0.2475 for IB , and 0.5122 for IO (Kumar et al., 2018).

The survey received responses from a total of 196 blood transfusion centers. The highest number of participants came from Uttar Pradesh with 24 centers, followed by Delhi with 11 centers, Haryana with 6 centers, Punjab and Chandigarh with 5 centers each, Uttarakhand and Jammu and Kashmir with 4 centers each in northern India. In the eastern part of the country, 16 centers are in West Bengal, 11 centers in Odisha, 4 centers in Assam, 3 centers in Jharkhand, 2 centers in Arunachal Pradesh, 3 centers in Bihar and 2 centers in Meghalaya. Two centers in Nagaland. There are two centers in Sikkim and two centers in Tripura. In the south, 14 centers are in Kerala and Karnataka, 11 centers in Tamil Nadu, 5 centers in Telangana, 4 centers in Puducherry, 2 centers in Andhra Pradesh and 1 center in Andaman and Nicobar. There are three centers.. In the central part of the country, Madhya Pradesh had 10 centers. From the west, Gujarat had 12 centers, Maharashtra had 11 centers, and Rajasthan had 6 centers. In total, 195 blood centers from 25 states and 4 Union Territories participated in the survey. Among responding blood centers, 60% were from the government/public sector, while the remaining 40% were from the private sector. The majority of participating blood centers (55.8%) were affiliated with teaching hospitals. Additionally, 67.5% of the blood centers (133 out of 196) supported COVID hospitals, with 20.3% (40 centers) located in the same building. (Basavarajegowda et al., 2021).

A total of 512 healthy Indian participants were enrolled in the study. Serum samples obtained from fasting blood were collectively analyzed for various analytes. The study utilized multiple regression analysis (MRA) and nested analysis of variance (ANOVA) to pinpoint potential sources of variation (SV) in the research findings. MRA results highlighted age and BMI as significant SVs for numerous analytes across both genders. ANOVA findings suggested that there exists an age and sex-specific distribution for 17 analytes and 5 analytes respectively. The interquartile range (IR) under parametric methods was observed to be narrower compared to non-parametric methods, indicating a skewed peripheral distribution of experimental results. Interestingly, the LAVE method did not significantly impact the IR, possibly due to inconsistencies in abnormal analyte values (Shah, Ichihara, Dherai, & Ashavaid, 2018).

Based on a thorough examination of scientific literature, it can be determined that hemolyzed samples are the primary reason for sample failure in clinical laboratories, accounting for 40-70% of cases. These include low sample size (10-20%), incorrect collection of the sample in the container (5-15%) and high concentration (5-10%).Other less frequent causes of compromised sample quality include contamination from infusion fluids (such as saline or glucose solutions), cross-contamination from blood tube additives, improper sample storage conditions, or repeated freeze-thaw cycles (Lippi, Von Meyer, Cadamuro, & Simundic, 2019).

There are 348,987 blood collection vials in the dataset. Blood disorders were found in a median of 6.7% of the adult culture groups and 1.1% of the child groups. Among the 27 hospitals, 11 hospitals treating elderly patients met the pollution level standard of less than 3%, and only two hospitals met the absolute pollution level standard of 1% or less. The proportion of adults with blood cultures varied from 2.7% to 29.0%. A correlation was observed between sampling rate and pathogen detection until BC was performed in 17% of adult admissions. The proportion of isolated BC varied from 47.8% to 94.4%. Of the 7,436 bleeding deaths in adults, approximately 1,745 were lost due to BC, failure to use anaerobic containers, or failure to perform BC. The average processing time was 51.2 hours, three times the optimal time. Time to diagnosis was 4.4 hours, 15.9 hours from culture to detection of growth, 4.5 hours from detection to Gram stain, and 30.9 hours from detection to isolation and identification (Temkin, Biran, Braun, Schwartz, & Carmeli, 2022).

Data analysis was performed to evaluate the contamination rate and adherence to completing the requisition form. SPSS version 22 was utilized for the examination. A significance level of $P < 0.005$ and $P < 0.01$ was deemed statistically significant. In the pre-intervention group, 13.7% of samples were contaminated, which decreased to 4.2% and 3.2% in regular and phlebotomist groups. The compliance of healthcare workers with different aspects of the blood culture collection protocol significantly increased during the intervention phase compared to the pre-intervention phase (Shaji et al., 2022).

3. Methodology

Phlebotomist in Healthcare has certain procedures to collect the samples manually by specimen instrument. The procedure is depicted as schematic representation in the Figure 3.

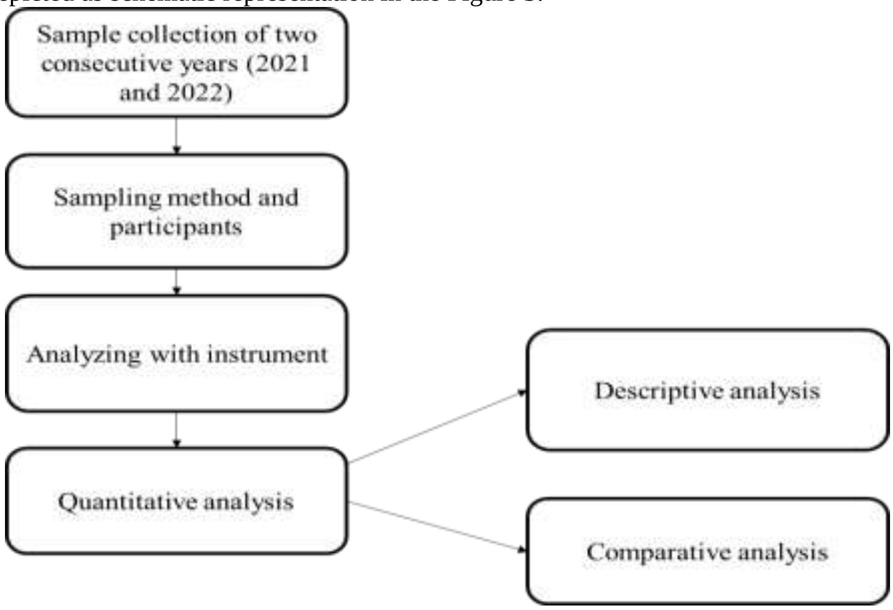

Figure 3 Research methodology of the specimen collection data

3.1 Study Area

The place of blood sample collection plays a crucial role in ensuring the accuracy and safety of the collected sample. Place for blood sample collection is a laboratory or a medical clinic. These facilities have trained professionals and specialized equipment to ensure the proper collection and handling of the blood sample. The environment is controlled, and all necessary precautions are taken to prevent contamination of the sample. In hospitals, blood samples are usually collected in the emergency department, intensive care units, or outpatient clinics. The advantage of collecting blood samples in a hospital is the availability of medical staff who can perform the procedure quickly and efficiently in case of emergencies.

3.2 Research Design

This benchmarking study included analysis of key performance indicators (KPIs) related to phlebotomy and specimen collection services for two sequential years (2021 and 2022). This study intentions to detect trends, variances and potential areas for improvement in the data postulated.

3.3 Sampling method and Participants

The research study is examined with the samples collected in a period of 18 months. The time duration of the sample collection is experimented during January-September (2021-2022). For almost 18 months, the collected samples are 2747248.

3.4 Research Instrument

1. Needles and Syringes

Needles and syringes are the most basic and commonly used instruments for blood sample collection. They are used to pierce the skin and draw blood from veins. The size of the needle and syringe used depends on the age of the individual and the amount of blood needed for the study. The most commonly used needle size for adults is 21-gauge, while 23-25 gauge needles are used for children and elderly individuals.

2. Blood Collection Tubes

Blood collection tubes are used to store and transport blood samples. These tubes come in different sizes and colours, each with a specific purpose. For instance, red-top tubes contain no additives and are used for collecting serum samples, while purple-top tubes contain an anticoagulant and are used for collecting plasma samples. It is crucial to select the appropriate tube for the specific research study to avoid contamination and ensure accurate results.

3. Lancets

Lancets are small, sharp blades used to prick the skin for capillary blood collection. They are commonly used for collecting blood from the finger or heel. Lancets are particularly useful when a small amount of blood is needed, such as in glucose testing. They are also relatively painless and reduce the risk of infection compared to using needles.

4. Vacuum Blood Collection Systems

A vacuum blood collection system is a closed system that consists of a needle, holder, and evacuated tubes. It is used to draw blood from a vein without the need for manual aspiration. The vacuum created in the tube allows for a controlled flow of blood, making it easier to collect the required amount of blood. This system also reduces the risk of exposure to blood-borne pathogens for both the patient and the healthcare worker.

5. Blood Lancet Devices

Blood lancet devices are spring-loaded devices used for capillary blood collection. They are an alternative to manual lancets and are particularly helpful when multiple blood samples need to be collected. These devices come with adjustable depth settings, making it easier to control the depth of the skin prick, resulting in more accurate and consistent blood collection.

6. Micro sampling Devices

Micro sampling devices are relatively new instruments used for collecting small volumes of blood samples. These devices use a minimally invasive approach and require only a tiny amount of blood, making it ideal for paediatric and elderly patients. The collected blood is usually stored on filter paper or in micro tubes, making it suitable for transportation and storage.

3.5 Quantitative analysis

Quantitative analysis of blood samples plays a significant role in healthcare as it provides important information about a patient's health status. For instance, the measurement of blood glucose levels is crucial in the diagnosis and monitoring of diabetes. Similarly, the measurement of hormones such as thyroid-stimulating hormone (TSH) and cortisol can help detect thyroid and adrenal gland disorders, respectively.

The process of collecting blood samples for quantitative analysis involves several steps. The first step is to identify the specific components to be measured and select the appropriate blood collection tubes and additives. These tubes are designed to preserve the integrity of the blood sample and prevent coagulation. The most commonly used tubes for quantitative analysis include serum separator tubes, heparin tubes, and EDTA tubes. The next step is to prepare the patient for the blood collection procedure. This includes explaining the process and obtaining informed consent, as well as checking for any contraindications or allergies. The collection site is then cleaned with an antiseptic solution to prevent contamination of the sample.

The blood is then collected using a sterile needle or lancet, and the appropriate amount is drawn into the collection tube. The tubes are then labelled with the patient's information and sent to the laboratory for analysis. It is crucial to follow proper handling and transportation protocols to ensure the accuracy of the results. Once the sample reaches the laboratory, the quantitative analysis process begins. The first step is to centrifuge the sample to separate the blood cells from the plasma or serum. The plasma or serum is then used for analysis, as it contains the desired components in their natural state.

Actual analysis is carried out using various techniques, such as spectrophotometry, chromatography, or immunoassays, depending on the component being measured. These methods are highly sensitive and can detect even small changes in the concentration levels of the components, making them valuable tools in medical diagnostics.

3.6 Ethical Considerations

Blood sample collection is the principle of respect for persons. This means that individuals have the right to make informed decisions about what happens to their bodies, including the collection and use of their blood. This principle highlights the importance of obtaining valid consent from the individual before collecting their blood sample.

Ethical consideration is the principle of non-maleficence, which emphasizes the duty to not harm others. In the context of blood sample collection, this means taking all necessary precautions to minimize the risk of harm to the individual. This includes following proper and sterile techniques to prevent the transmission of infections, as well as using appropriate equipment and trained personnel to minimize pain and discomfort during the procedure.

Confidentiality is another important ethical consideration in blood sample collection. This principle requires respect for the privacy and confidentiality of the individual throughout the process. This includes protecting your privacy and ensuring that blood samples are not used or shared without your express consent, except as required by law.

Equity and fairness are also crucial ethical considerations in blood sample collection. This means that all individuals should have equal access to the procedure, regardless of their socioeconomic status, race, gender, or any other personal characteristic. Additionally, collected blood samples should be used for the benefit of the larger community and not just for the individual from whom it was taken.

4. Results

Phlebotomists collects the specimen manually and analysis is performed for the collected sample of the specimens. Descriptive analysis and comparative analysis of the consecutive years 2021 and 2022. With the help of these analysis results, sample collection of these can be compared and analysed with descriptive values. Table 1 depicts about the descriptive analysis of the data's specimen collection by the Phlebotomists in the year 2021 to 2022.

Table 1 Descriptive analysis of specimen collection by Phlebotomists of the data from 2021 to 2022

Descriptive analysis of (2021 and 2022)	**Mean**	**Median**	**Std. dev**	**Min**	**Max**
Samples	1,53,007	1,40,724	48,624	78,691	2,84,755
Tickets_Hematoma	42	45	30	7	120
Bookings_NPS	15,758	14,932	6,535	4,444	29,199
Bookings_NPS (Distinct)	15,347	14,932	6,458	4,300	28,666
Tickets_Phelo_Hygiene	55	53	33	20	108
Tickets_Phelo_Misbehave	93	87	57	35	187
Tickets_Phelo_Not_Reached	316	288	111	210	464
Rejected_Samples	20,093	18,316	7,023	3,079	18,053
Tickets_Wrong_NAG	543	535	115	214	1,088
Total Tickets:	1,356	1,183	422	508	2,239

Percentage:	0.83%	0.68%	0.33%	0%	14%

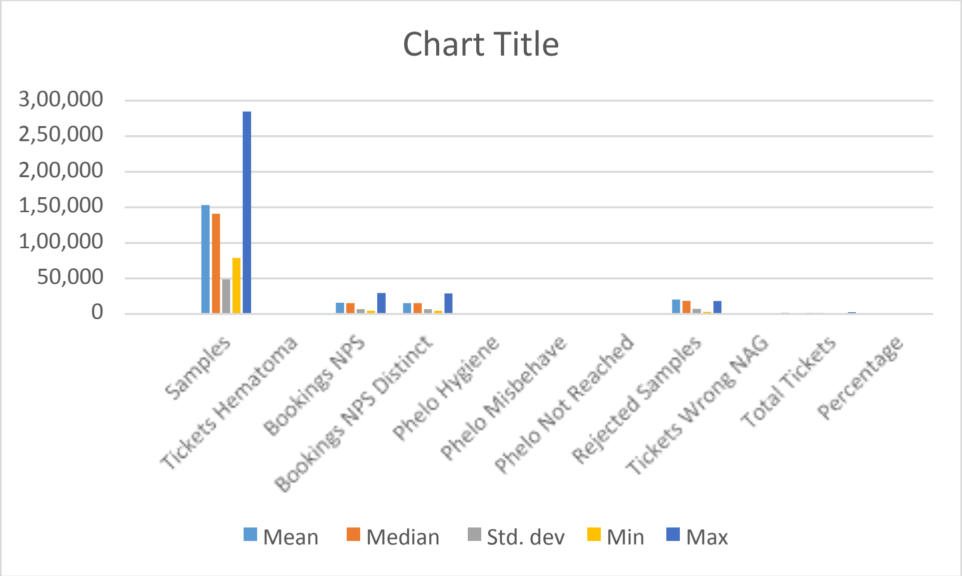

Figure 4 Descriptive analysis of the specimen collection of the consecutive years 2021 and 2022

Table 1 illustrates descriptive analysis of the sample collection depicting samples from 2021 and 2022. Samples from 2021 and 2022 are described as mean 153,007 samples, median 140,724, minimum 48,624, and maximum 284,755. The hematoma patient sample was considered with mean 42, median 45, standard deviation 30, minimum 7 and maximum 120 patient slips. Entire descriptive analysis rate of 2021 and 2022, average is 0.83%, median is 0.68%, standard deviation is 0.33%, minimum value is 0%, maximum value is 14%.From the descriptive analysis of 2021 and 2022 it is possible to describe the central tendency, shape and dispersion of the collected samples.

Table 2 Comparative analysis of specimen collection data by Phlebotomists of 2021 and 2022 average values

	2021: Average	2022: Average
Samples	1,31,509	1,73,740.33
Tickets_Hematoma	37.67	33.33
Bookings_NPS	12,555	24,390.67
Rejected_Samples and Tickets_Wrong_NAG	18,662	10,864.67
Total tickets	1,062,33	608.33
Percentage	0.98%	0.58%

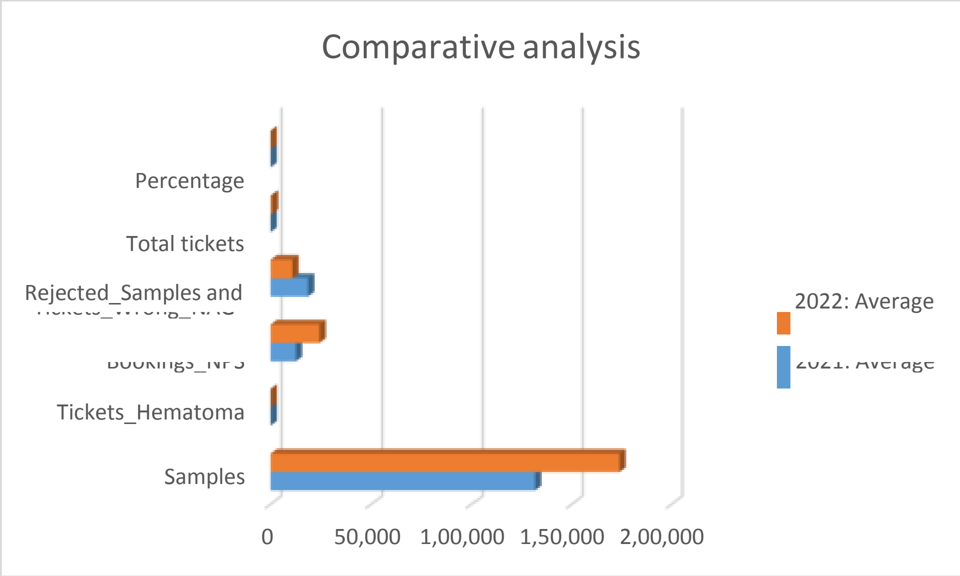

Figure 5 Average values of the 2021 and 2022 samples

The average values of data sample collection by phlebotomists are compared and distinguished from the average values for the years 2021 and 2022 depicted in Table 2.The average sample for 2021 is 131,509 and for 2022 is 173,740.33.Hematoma tickets are valid in 2021 for 37.67 and in 2022 for 33.33. The average NPS booking value is 12,555 for 2021 and 24,390.67 for 2022.NAG's bad ticket and rejected sample for 2021 is 18,662 and for 2022 it is 10,864.67.Of the total number of tickets booked in 2021 and 2022, the average value is 106233 and 608.33.The overall specimen collection rate in 2021 was 0.98%.0.58% is the average value of sample collection data in 2022.When comparing two consecutive years, this leads to differences and correlations in sample collection data. From the results, it can be concluded that 2021 has more sample collection data than 2022.

5. Discussions

The evaluation of 4778 samples involved an assessment of quality and quantity of specimens, as well as the accuracy of results and healthcare safety parameters. This assessment was conducted using an open blood collection system. Later, phlebotomists were trained to switch to a closed blood collection system. The same parameters were studied in another 2508 blood samples collected using a closed collection system by the same phlebologist. The open blood collection system used sterile tubing, a 5 mL syringe, and a 23G needle. On the other hand, the closed blood collection system used the BD Vacationer, the Eclipse TM 22G safety needle and the pronto TM safety disposable holder. This comprehensive survey was conducted from January 1 to March 31, 2021. Implementing a closed collection system not only improved accuracy and safety, but also reduced the number of blood collection containers or blood transfusions in testing applications. These improvements have contributed to the safety of healthcare workers (Sankar, Jayalakshmy, Jim, & Deepa, 2022).

Out of 231,008 blood samples, 11,897 samples were rejected. The primary pre-analytical error observed was storage problems caused by transportation delays, with incorrect medical records being the second most common issue. Other reasons for rejection included diluted samples, incorrect tubes, haemolysed samples, unlabelled samples and clotted samples (Noor et al., 2023).

Venipuncture is the primary method for blood collection in hospitalized patients, with an average of 1.6 to 2.2 collection episodes per day. A recent study conducted on inpatients revealed that only 27% of attempts to collect blood samples through PIVCs within a specific time frame were successful, meeting the criteria of sufficient sample volume and minimal haemolysis (Psaila, Parsons, Hahn, & Fichera, 2023).

296 patients were included in the study and capillary and venous blood samples were collected simultaneously. Capillary samples were collected in serum tubes for analysis of 22 normal biochemical parameters after centrifugation, and venous samples in EDTA tubes for analysis of 15 hematological parameters. Process quality before analysis using a quality reference model. The results showed that the hemolysis index was significantly higher in capillary samples compared to venous blood samples. However, regression and difference-in-difference analyzes showed no bias between the two types of samples for all biochemical and hematological parameters studied except mean corpuscular volume (MCV). For model stability, the percent degradation exceeded the minimum analytical performance requirements. Multiple parameters. Also, participants who had blood tests done more than once a year reported that finger pricks were less painful than venipuncture. (Maroto-García et al., 2023).

6. Limitations

The major limitations of the manual is its lack of specificity for Indian healthcare system. The manual is primarily based on international standards and guidelines, which may not always be applicable or relevant to the Indian healthcare system. The manual does not take into account of unique challenges and constraints faced by healthcare professionals in India such as resource limitations, cultural sensitivities, and language barriers. This can make it difficult for phlebotomists to implement the manual's recommendations in their day-to-day work (Grover, Sahoo, Bhalla, & Avasthi, 2018).

The manual does not provide enough guidance on how to handle situations that are specific to the Indian context. For instance, in India, it is common for patients to have multiple family members present during a home visit. This can pose a challenge for phlebotomists as they may have to deal with distractions while collecting specimens. The manual does not address this issue and does not provide any strategies for managing such situations. This can lead to suboptimal specimen collection and potentially compromise the accuracy of test results (Lewinsohn et al., 2017).

Limitation of the manual is its limited focus on the use of technology in specimen collection. With the rise of telemedicine and home-based healthcare services in India, the use of technology has become increasingly prevalent in specimen collection. However, the manual does not provide adequate guidance on how to integrate technology into the collection process. This can be a significant hindrance for phlebotomists working in a Healthcare at Home Service Provider setting, where the use of technology is crucial for efficient and accurate specimen collection (da Cunha Santos, Saieg, Troncone, & Zeppa, 2018).

The manual does not address the issue of cultural competency in specimen collection. In a diverse country like India, where cultural beliefs and practices vary greatly, it is essential for phlebotomists to be culturally sensitive and aware. This is particularly important when collecting specimens from patients who belong to marginalized communities or have specific cultural beliefs that may impact the collection process. The manual does not provide any guidance on how to navigate these cultural differences, which can lead to misunderstandings and potential conflicts during the collection process (Alizadeh & Chavan, 2016).

The manual also lacks updates and revisions. The healthcare industry is constantly evolving, and new technologies, techniques, and guidelines are being introduced regularly. However, the manual has not been updated in many years, which means that it may not reflect the current best practices in specimen collection. This can be a significant hindrance for phlebotomists who rely on the manual for guidance and may lead to outdated practices being followed (Barbé et al., 2016).

7. Conclusion

It is a comprehensive guide that aims to improve the quality of specimen collection and handling in the home healthcare setting. This manual covers all aspects of phlebotomy, from the basics of anatomy and physiology to the proper techniques for collecting and handling different types of specimens. The key strengths of this manual is its focus on the unique challenges faced by phlebotomists working in the home healthcare setting in India. The manual recognizes the cultural and logistical barriers that may be encountered while providing services in patients' homes and offers practical solutions for overcoming them. This will not only improve the efficiency of specimen collection but also ensure patient safety and satisfaction. Manual emphasizes the importance of proper communication and collaboration between phlebotomists and other healthcare professionals involved in the patient's care. This will lead to better coordination and integration of services, ultimately resulting in better outcomes for the patient. The manual also highlights the importance of following standard protocols and safety measures to prevent the spread of infections and reduce the risk of errors. With the increasing prevalence of antibiotic resistance and new infectious diseases, it is crucial for phlebotomists to be well-informed and trained in infection control practices. The manual provides valuable insights into the legal and ethical aspects of specimen collection, ensuring that phlebotomists adhere to the highest standards of professionalism and integrity while carrying out their duties.

Declarations

- Conflict of Interest: The author reports that there is no conflict of Interest.
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- Acknowledgement: None
- Data Availability Statement: The author do not have permission to share data.
- Ethics Approval: Not Applicable

REFERENCES:

1. Alizadeh, S., & Chavan, M. (2016). Cultural competence dimensions and outcomes: a systematic review of the literature. *Health & social care in the community, 24*(6), e117-e130.

2. Barbé, B., Verdonck, K., Mukendi, D., Lejon, V., Lilo Kalo, J.-R., Alirol, E., . . . Bottieau, E. (2016). The art of writing and implementing standard operating procedures (SOPs) for laboratories in low-resource settings: review of guidelines and best practices. *PLoS neglected tropical diseases, 10*(11), e0005053.

3. Basavarajegowda, A., Bajpai, M., Arora, S., Maheshwari, A., Dua, S., & Sahoo, D. (2021). Survey based cross-sectional study to analyse the variation of practices at blood centres during COVID-19 pandemic in India. *Transfusion and Apheresis Science, 60*(3), 103131.

4. da Cunha Santos, G., Saieg, M., Troncone, G., & Zeppa, P. (2018). Cytological preparations for molecular analysis: a review of technical procedures, advantages and limitations for referring samples for testing. *Cytopathology, 29*(2), 125-132.

5. Eric, K. I. (2023). Quality and Safety in Phlebotomy Units of Medical Structures.

6. Gnidovec, T., Žemlja, M., Dolenec, A., & Torkar, G. (2020). Using augmented reality and the structure–behavior–function model to teach lower secondary school students about the human circulatory system. *Journal of Science Education and Technology, 29*, 774-784.

7. Grover, S., Sahoo, S., Bhalla, A., & Avasthi, A. (2018). Psychological problems and burnout among medical professionals of a tertiary care hospital of North India: A cross-sectional study. *Indian journal of psychiatry, 60*(2), 175.

8. Kumar, S., Modak, P. K., Ali, S. H., Barpanda, S., Gusain, V. S., & Roy, R. (2018). A retrospective study: ABO and Rh phenotype blood group distribution among blood donors in HNB Base Hospital, Srinagar, Uttarakhand, India. *Journal of Family Medicine and Primary Care, 7*(1), 34.

9. Lenicek Krleza, J., Dorotic, A., Grzunov, A., & Maradin, M. (2015). Capillary blood sampling: national recommendations on behalf of the Croatian Society of Medical Biochemistry and Laboratory Medicine. *Biochemia medica, 25*(3), 335-358.

10. Lewinsohn, D. M., Leonard, M. K., LoBue, P. A., Cohn, D. L., Daley, C. L., Desmond, E., . . . Mazurek, G. H. (2017). Official American Thoracic Society/Infectious Diseases Society of America/Centers for Disease Control and Prevention clinical practice guidelines: diagnosis of tuberculosis in adults and children. *Clinical Infectious Diseases, 64*(2), e1-e33.

11. Lima-Oliveira, G., Lippi, G., Salvagno, G. L., Picheth, G., & Guidi, G. C. (2015). Laboratory diagnostics and quality of blood collection. *Journal of medical biochemistry, 34*(3), 288.

12. Lippi, G., Von Meyer, A., Cadamuro, J., & Simundic, A.-M. (2019). Blood sample quality. *Diagnosis, 6*(1), 25-31.

13. MACHARIA, B. K. (2018). *APPROPRIATENESS OF PERSONAL PROTECTIVE EQUIPMENT AGAINST BIO-HAZARDS EXPOSURE IN PUBLIC PRIMARY HEALTHCARE FACILITIES IN MOMBASA COUNTY, KENYA.* JKUAT-COHES.

14. Mammen, J. J., Asirvatham, E. S., Lakshmanan, J., Sarman, C. J., Pandey, A., Ranjan, V., . . . Upadhyaya, S. (2022). The clinical demand and supply of blood in India: A National level estimation study. *PloS one, 17*(4), e0265951.

15. Maroto-García, J., Deza, S., Fuentes-Bullejos, P., Fernández-Tomás, P., Martínez-Espartosa, D., Marcos-Jubilar, M., . . . González, Á. (2023). Analysis of common biomarkers in capillary blood in routine clinical laboratory. Preanalytical and analytical comparison with venous blood. *Diagnosis*(0).

16. Noor, T., Imran, A., Raza, H., Umer, S., Malik, N. A., Chughtai, A. S., . . . Chughtai, A. (2023). An Overview of Complete Blood Count Sample Rejection Rates in a Clinical Hematology Laboratory Due to Various Preanalytical Errors. *Cureus, 15*(1).

17. Omonayin, M. G. (2022). *Staff Nurse Education on Best Practices for Preventing Blood-Borne Pathogen Exposures.* Walden University.

18. Organization, W. H. (2016). Diagnostic stewardship: a guide to implementation in antimicrobial resistance surveillance sites: World Health Organization.

19. Paul, I. I., Victoria, M., & Olalere, O. S. (2023). Patient turnaround time: Concern of medical laboratory scientist. *Sokoto Journal of Medical Laboratory Science, 8*(1).

20. Psaila, J., Parsons, T. F., Hahn, S. A., & Fichera, L. (2023). Prospective Study Evaluating Whether Standard Peripheral Intravenous Catheters Can Be Used for Blood Collection Throughout Hospital Stay. *Journal of Infusion Nursing, 46*(1), 43.

21. Sankar, S., Jayalakshmy, P., Jim, J., & Deepa, S. (2022). The Impact of Open Vs. Closed Blood Collection on Specimen Quality, Health Care Worker Safety, & Work Efficiencies, at a Tertiary Care Centre in South India. *Journal of Evolution of Medical and Dental Sciences, 11*(2), 369-375.

22. Shah, S. A., Ichihara, K., Dherai, A. J., & Ashavaid, T. F. (2018). Reference intervals for 33 biochemical analytes in healthy Indian population: C-RIDL IFCC initiative. *Clinical Chemistry and Laboratory Medicine (CCLM), 56*(12), 2093-2103.

23. Shaji, R., Madigubba, H., Priyadarshi, K., Anandh, P., Nathan, B., Vivekanandan, M., & Sastry, A. S. (2022). Effectiveness of multimodal intervention to improve blood culture collection in the emergency department. *Journal of Global Infectious Diseases, 14*(1), 10.

24. Temkin, E., Biran, D., Braun, T., Schwartz, D., & Carmeli, Y. (2022). Analysis of Blood Culture Collection and Laboratory Processing Practices in Israel. *JAMA Network Open, 5*(10), e2238309-e2238309.

25. von Meyer, A., Lippi, G., Simundic, A.-M., & Cadamuro, J. (2020). Exact time of venous blood sample collection–an unresolved issue, on behalf of the European Federation for Clinical Chemistry and Laboratory Medicine (EFLM) Working Group for Preanalytical Phase (WG-PRE). *Clinical Chemistry and Laboratory Medicine (CCLM), 58*(10), 1655-1662.

26. Żytkowski, A., Tubbs, R. S., Iwanaga, J., Clarke, E., Polguj, M., & Wysiadecki, G. (2021). Anatomical normality and variability: Historical perspective and methodological considerations. *Translational Research in Anatomy, 23*, 100105.