

Impact of Blood Sampling in Critical Care Settings in South India: Prospective Observational Study

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Abstract: Background: Frequent and unnecessary sampling could lead to blood loss, which is a major factor causing iatrogenic anaemia. Optimising blood sampling practices could help prevent the need for blood transfusions. Our study aims to assess the blood loss, haemoglobin drop, and blood transfusion requirement due to blood sampling in critical care units. **Methods:** A prospective observational study was carried out in the adult critical care units of a tertiary care hospital over three months in Coimbatore, South India. A total of 193 consecutive patients were included by convenience sampling. Blood loss incurred other than blood sampling was observed to negate the bias. **Results:** Thirty-one (15.8%) patients experienced a significant drop in haemoglobin, and the average blood volume drawn was 87 ml per patient during ICU admission. Patients with invasive catheters incurred higher blood loss and received more blood transfusions (63 units) compared to those with non-invasive catheters (4 units). Unplanned blood samples (stat) were 1186 (9.96 per patient) with invasive catheters. The calculated p-value for blood wastage and transfusion is highly significant ($p=0.013$). The highly substantial p-values were seen for blood withdrawn between invasive sampling and peripheral sampling per patient and per day ($p=0.000$ & $p=0.00$). **Conclusion:** Our study suggests that reducing the incidence of iatrogenic anaemia and blood transfusion requirements is possible using a closed blood sampling system, especially for sicker patients and those expected to stay for more than 5 days, avoiding unplanned and frequent investigations, using small-volume blood collection tubes, and planned blood sampling timings 12 hours apart as an ICU protocol.

Keywords: Anaemia; Blood Sampling; Blood Transfusion; Hospital-Acquired Anaemia; Intensive Care Unit; Packed Red Blood Cells; Small Volume Tubes.

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I. INTRODUCTION

➤ Background

Blood sampling is an inevitable day-to-day practice among critically ill patients for essential monitoring, diagnosis, and treatment. A significant amount of blood loss is incurred for multiple investigations needed during the resuscitation phase of severely ill patients. The frequency of checking such patients is also vital; hence, increased blood

sampling must be appropriately individualized; otherwise, it can result in higher blood sampling volume and frequency. Sometimes clinicians might repeat the test (within an hour or a day) to confirm unanticipated huge variations in laboratory reports and the effects of treatment or interventions. Also, to know the trends in unstable patients, frequent sampling is vital. The volume of blood sampled depends on the number and frequency of investigations⁽¹⁾.

Hamilton ⁽²⁾ et al. (2018) study revealed that median blood loss due to laboratory testing was 25 ml per patient per day and 213 ml per patient over the entire Intensive Care Unit (ICU) stay, and 47.5% of patients received blood transfusions, averaging 3 units. In addition, 150 ml of blood drawn for laboratory testing from day two to seven of ICU admission was associated with blood transfusions. JC Adams ⁽³⁾ and his team (2022) found that the average blood volume loss per day is 7.0 ml and 13.6 ml for the entire ICU admission duration.

Blood sampling can be an important reason for a drop in haemoglobin and hematocrit for patients who stay in critical care areas for a longer duration, resulting in iatrogenic anaemia. Anaemia could reduce oxygen delivery to vital organs and tissue oxygenation. This could result in significant morbidity, increased length of stay in the ICU, increased health care costs, increased infection risks, blood transfusion-related complications, and a potential negative impact on recovery. Coene KLM et al., study found that 140 ml of blood wasted during 3.5 days of ICU stay solely for laboratory purposes and risk of developing iatrogenic anaemia was proven to increase by 20% with each 50 mL of blood sampled ⁽⁴⁾, another study stated that for every 50 mL of blood withdrawal, the risk of hospital-acquired anaemia (HAA) increased by 18%.⁽⁵⁾

Adrian Cioc et al. (2015) conducted a prospective study with 35 ICU patients about daily phlebotomy and haemoglobin levels in a Romanian ICU. They reported that the per day mean blood withdrawal was 18.1 ml, and the number of blood tests was 3.8, and those findings correlated with a drop in haemoglobin levels. The significant difference between admission and discharge haemoglobin correlated with overall mortality ($p = 0.03$), with a specificity of 50%. They suggested limiting the daily routine blood tests ⁽⁶⁾.

The practice of discarding the blood-mixed fluid with the invasive catheter before obtaining a blood sample results in significant wastage of blood. This would be relevant, especially when blood sampling is done for a single investigation rather than grouping them.

In our ICU, we have the practice of discarding the first volume of blood mixed with intravenous fluid within the invasive catheters to improve the accuracy of the blood sampled and not return the blood-mixed fluid due to potential infection risk. Nowadays, a device or closed system is available in the market to avoid blood wastage from invasive catheters, but it is relatively expensive for developing countries. Small-sized blood sampling tubes and a closed system as a combined approach are good alternative options to reduce the blood withdrawal ^(7,8).

A systematic review assessed the effectiveness of closed blood sampling systems and recommended the use of closed blood sampling systems to reduce blood wastage and catheter-related infection rates in ICUs ⁽⁹⁾. A systematic review by Keogh S et al. (2023) to compare blood sample volumes and haemoglobin changes, transfusion requirements, and infection. They included eight studies with 1027 patients and found that the closed-loop system decreased blood sampling volume and catheter-related bloodstream infections ⁽¹⁰⁾.

➤ Objectives

- To assess the blood loss and haemoglobin drop during the entire ICU admission.
- Comparing the haemoglobin changes (admission & discharge) during ICU stay and Blood transfusion.
- Comparing blood wastage, haemoglobin drop and PRBC transfusion in patients with invasive catheter sampling and peripheral sampling.
- To correlate the duration of stay with blood loss and haemoglobin drop.
- To compare the invasive catheter sampling and the peripheral puncture sampling

II. MATERIALS AND METHODS

The present study used a quantitative, prospective observational study to evaluate the impact of blood sampling among critically ill patients in critical care units over three months (1st March to 31st May 2024) at a tertiary care multi-speciality hospital in Coimbatore, Tamil Nadu.

Patients who were admitted to multispecialty ICUs were eligible for this study. 344 patients were admitted to multispecialty ICUs and were eligible for participation in the study. We excluded patients who were i) admitted with bleeding/bleeding disorder, ii) pre-existing Severe Anaemia (Haemoglobin <7gm/dl), iii) documented source of blood loss apart from blood sampling and patients with incomplete details. A total of 193 patients were included in the study through a convenience sampling technique who met the criteria.

The primary outcome of the study was to determine the blood loss and haemoglobin drop due to blood sampling. Secondary outcomes included assessing the requirement for blood transfusion, the impact of invasive catheter sampling, and the frequency of sampling.

Institutional Review Board (IRB) Ethical clearance was obtained from the study setting (XXXX). No participant-identifying information was collected. No participants were forced to participate in the study. All ethical principles were followed throughout the study period.

The data collection procedure started with obtaining approval from the Institutional Review Board (IRB) and securing informed consent from all participants, ensuring ethical standards and confidentiality. The study was conducted for a period of 12 weeks (1st March to 31st May 2024). Convenient sampling techniques were used to select the samples. The researcher and bedside staff entered the data on the data collection sheets as soon as sampling was completed, and the data sheets were collated upon discharge and analysed.

Data analysis was done using descriptive statistics and inferential statistics methods, using Statistical Package for the Social Sciences (SPSS) version 16, STATA version 16.0.

III. RESULTS

The study included 193 patients; most patients, 70.5% (136), were males, and 29.5% (57) were females. (Figure 1)

Most patients, 34.7% (67), were in the 41-60 years age group, followed by 34.1% (66) in the 61-80 years age group. The patients were categorised by their admission diagnosis. Among the 193 participants, the largest part, 18.65% (36 patients), were admitted due to neurological problems, followed by trauma patients (15%).

About the subject's blood loss (blood test and invasive catheters priming volume) and haemoglobin drop during the entire ICU admission. The average blood drawn for sampling was 87.07 ml per patient and 15.8 ml per day. The haemoglobin drop due to blood sampling was 7.87% (1.03g/dl) per patient and 1.43% (0.19g/dl) per day. (Table 1)

The section on the comparison of haemoglobin changes (admission and discharge) during the ICU stay and blood transfusion among the participants. The lower the haemoglobin level, the higher the transfusion needs. The transfusion need was at a much higher (31 units) level, especially among the 7.1 to 8 gm/dl group of patients (Figure 2).

On the comparison of haemoglobin drop and blood wastage between invasive catheter sampling and peripheral puncture sampling: Among the 193 participants, 119 (61.6%) patients had invasive catheters for blood sampling, and 74 (38.3%) patients' blood sampling was done through peripheral punctures. Those with invasive catheters had an average of 42.52% (53 ml) of blood wasted during sampling, 10.25% (1.37g/dl) haemoglobin dropped and received 63 units of PRBC. Peripheral puncture sampling patients had a 4.04% (0.5g/dl) haemoglobin drop and received only four units of PRBC. Significant correlation between blood wastage and PRBC transfusion ($p=0.013$) and Haemoglobin drop and PRBC transfusion ($p=0.034$). (Table2)

About the length of ICU stay with blood loss and haemoglobin drop: 148 (76.6%) patients were admitted for a week, among them, blood loss was 49.09ml, and haemoglobin drop was 5.33% (0.7g/dl). 45 (23.3%) patients were admitted for more than seven days, among them, blood loss and haemoglobin drop were high (211.98ml, and 16.21%, 2.13 g/dl respectively). This observation directly explains the proportional increase in blood loss and haemoglobin drop as the length of ICU stay increases. Significant p-value between length of ICU stay and Haemoglobin drop between groups (0.021 and 0.005, respectively) (Table 3)

The comparison of sampling between the patients with invasive catheter and peripheral sampling: The average number of stat order sampling is higher in the invasive catheter group, with an average of 9.96 tests done, compared to the peripheral sampling group with 3.32 tests. Among routine sampling, the invasive catheter group had an average of 1.0 tests, and the peripheral sampling group had 2.58 tests. On the total number of samples, the invasive catheter sampling group

had an average of 16.95 tests, and the peripheral sampling group had 5.4 tests. (Table 4)

IV. DISCUSSION

The study aimed to assess the blood loss and haemoglobin drop during the ICU admission, due to blood sampling. We also looked at the impact of invasive catheter sampling and the frequency of sampling. By assessing the variables, the study found that there is a significant impact on blood loss (15.8 ml per day) and haemoglobin drop (1.03g/dl per patient) due to the blood sampling. Moreover, invasive catheter sampling patients had an average of 42.52% (53 ml) of blood wasted during sampling, 10.25% (1.37g/dl) haemoglobin dropped and received 63 units of PRBC. Peripheral puncture sampling patients had a 4.04% (0.5g/dl) haemoglobin drop and received only four units of PRBC.

The demographic variables in this study showed that among 193 patients, most patients 70.5% (136) were males, and 29.5% (57) were females. Most patients, 34.7% (67), were in the 41-60 years age group, followed by 34.1% (66) in the 61-80 years age group. The patients were categorised by their admission diagnosis; the largest part of 18.65% (36 patients) were admitted due to neurological problems, followed by trauma patients (15%). Similar proportions were found in five Spanish studies ⁽¹⁾.

A noteworthy discovery in our study was that the average blood drawn per patient during the ICU stay was 87.07 ml, and the average blood drawn per day was 15.8 ml. A similar finding was seen by Cioc ⁽⁶⁾ et al, and Dolman ⁽¹³⁾ et al., however saw a higher volume of blood loss. Many similar studies have noted daily phlebotomy losses of blood ranging from 40 to 70 mL every day and 280 mL per week ⁽¹⁴⁾. Compared to the international studies, our centre found marginally decreased blood drawn per day and blood transfusion requirements ⁽¹⁵⁾. Nevertheless, many studies strongly suggest that the volume of sampling can be reduced by using small-volume tubes ⁽¹⁵⁻¹⁷⁾.

Another important result was found in the study in the 7.0 to 8.0 g haemoglobin group. The number of patients with Admission Haemoglobin of 7.0 to 8.0 g/dL was 21, the number of patients with discharge Haemoglobin of 7.0 to 8.0 g/dL was 26, and 31 units of PRBC were transfused in this category of patients to maintain the haemoglobin level, which highlighted the possibility of a higher incidence of iatrogenic anaemia. In addition, many studies found that blood sampling and volume contribute to ICU-acquired anaemia ^(14,18). Recent studies showed that 40% to 66.9% of ICU patients receive at least one PRBC transfusion, with a mean of 5 units per patient in the entire ICU course, even though their admission haemoglobin is around 8.5 g/dL ^(1,17).

Another observation comparing the haemoglobin drop was interesting. Patients who had a peripheral puncture sampling had a 4.04% (0.5g/dl) haemoglobin drop. Whereas a 10.25% (1.37g/dl) Haemoglobin drop was seen in patients who had invasive catheter blood sampling. These findings suggest that patients with invasive catheter blood sampling experienced a greater drop in haemoglobin due to blood

wastage from discarding residual blood mixed fluid (5 ml) in invasive catheters for the accuracy of laboratory results, and these results suggest reducing the discarded blood volume. Some of the supportive studies suggest reducing the discarded blood volume to less than 5ml⁽¹⁹⁻²⁰⁾.

It's worth noting that the blood sampling wastage in the invasive catheter was at an average of 53 ml, with as high as 315 ml of blood loss. Additionally, these patients received 63 units of PRBC transfusion, which is very high compared with those who had peripheral sampling, where they required only four units of PRBC transfusion. These results reveal that invasive catheters and open sampling lead to huge blood waste, causing iatrogenic anaemia and warranting PRBC transfusions. The severity of the illness needing an invasive catheter should be borne in mind as well. Many trials have noted that the closed sampling system will help to reduce the blood sampling wastage and need for blood transfusions^(7,8).

Patients who were admitted for a week had a blood loss of 16.62 ml, and a haemoglobin drop was 180.75% (0.24g/dl) per day. Patients who were admitted for more than seven days had almost similar blood loss and haemoglobin drop (15.23 ml and 0.15 g/dl, respectively). These results strongly suggest that increased blood loss and haemoglobin drop, positively correlated with the duration of the ICU stay ($p=0.021$ and $p=0.005$, respectively). 90% of critically ill patients had a drop in haemoglobin by the third day of stay, and 97% by the eighth day of stay. The findings suggest that the use of a closed system and small-volume blood sampling tubes could reduce blood loss and prevent iatrogenic anaemia, especially among patients with more than seven days of ICU stay^(6,12).

Another interesting finding in this study regarding blood sampling (stat, routine, and total number of sampling) was higher in the invasive catheter sampling group (9.96, 1.0, and 16.95, respectively) compared to the peripheral sampling group (3.32, 2.58, and 5.4, respectively). This alarming result is a critical factor in causing iatrogenic anaemia and infection risks among the invasive catheter sampling group. The United Kingdom study supports the findings that patients who have invasive catheters have had frequent sampling twice or three times compared with peripheral sampling⁽¹¹⁾. Moreover, these studies strongly recommend that lab orders be carefully planned and scheduled, if possible, clubbed with the next sampling to reduce frequency, blood loss, need for transfusion, and catheter-related bloodstream infection.

The study was limited by the duration, and randomization was not done.

V. IMPLICATIONS FOR PRACTICE

The present study highlights that reducing the incidence of iatrogenic anaemia and blood transfusion requirements is possible using a closed blood sampling system, especially for sicker patients and those expected to stay for more than 5 days, avoiding unplanned and frequent investigations, using small-volume blood collection tubes, and Planned blood sampling timings 12 hours apart as an ICU protocol. Therefore, healthcare providers, especially nurses and doctors, are strongly encouraged to follow the suggestions to improve

clinical outcomes and prevent iatrogenic anaemia and blood transfusion requirements.

VI. CONCLUSIONS

The research points out that blood loss, haemoglobin drop, and the requirement for blood transfusion are directly proportional to the frequency and volume of blood sampling. Furthermore, invasive catheter sampling had a significant impact on blood loss, iatrogenic anaemia, and blood transfusion needs.

The study strongly recommended that lab orders be carefully planned and scheduled, if possible, clubbed with the next sampling to reduce frequency, blood loss, need for transfusion, and catheter-related bloodstream infection. Additionally, the use of point-of-care testing, nursing education, and clear hospital protocols will help reduce the above complications in critical care settings.

Future studies must be conducted to compare the effectiveness of open vs. closed system sampling and small-volume tubes vs. standard-volume tubes.

➤ *Clinical Significance:*

- Optimizing blood sampling practices could prevent the need for blood transfusion.
- Our recommendations could reduce the incidence of iatrogenic anaemia and blood transfusion requirements.

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REFERENCES

- [1]. Juárez-Vela R, Andrés-Esteban EM, Gea-Caballero V, Sánchez-González JL, Marcos-Neira P, Serrano-Lázaro A, et al. Related Factors of anaemia in critically ill patients: a prospective multicenter study. *J Clin Med*. 2022;11(4):1031.
- [2]. Tyler Edward James, Rebecca Barty, Yang Liu, Bram Rochweg, Nancy Heddle, Deborah M Siegal; Blood Loss Due to Laboratory Testing in Critical Care Patients: A Retrospective Cohort Study. *Blood* 2018; 132 (Supplement 1): 4885. doi: <https://doi.org/10.1182/blood-2018-99-114289>
- [3]. Adams JC, Barrett C, Spruyt M. Iatrogenic blood loss in critical care: A prospective observational study conducted at Universitas Academic Hospital in the Free State Province, South Africa. *South Afr J Crit Care*. 2022 Aug 5;38(2) doi: 10.7196/SAJCC. 2022.v38i2.539.
- [4]. Coene KLM, Roos AN, Scharnhorst V. Iatrogenic anemia/Twenty-five million liters of blood into the sewer: comment. *J Thromb Haemost* 2015; 13: 1160–1.
- [5]. Martin ND, Scantling D. Hospital-acquired anemia: a contemporary review of etiologies and prevention strategies. *J Infus Nurs*. 2015;38(5):3308.

[6]. Cioc A, Fodor R, Benedek O, Moldovan A, Copotoiu SM. Blood sampling as a cause of anemia in a general ICU - a pilot study. *Rom J Anaesth Intensive Care*. 2015 Apr;22(1):13-16. PMID: 28913450; PMCID: PMC5505326.

[7]. Keogh S, Dhanani J, Levido A, et al. Evaluation of a closed loop-blood sampling system in intensive care: A pilot randomised controlled trial. *The ENCLOSE trial. Intensive Crit Care Nurs*. 2023 Apr; 75:103364. doi: 10.1016/j.iccn.2022.103364. Epub 2022 Dec 15. PMID: 36528456.

[8]. Siegal DM, Belley-Côté EP, Lee SF, et al, Small-Volume Blood Collection Tubes to Reduce Transfusions in Intensive Care: The STRATUS Randomized Clinical Trial. *JAMA*. 2023 Nov 21;330(19):1872-1881. doi: 10.1001/jama.2023.20820. PMID: 37824152; PMCID: PMC10570918.

[9]. Torredà, Marta & Arias-Rivera, S. & Delgado, María & Campos Asensio, Concepción & Fernández-Castillo, Rafael-Jesús. (2023). Effectiveness of closed blood sampling systems in intensive care patients: a scoping review. *Enfermería Intensiva (English ed.)*. 35. 10.1016/j.enfie.2023.05.001.

[10]. Keogh S, Mathew S, Ullman AJ, Rickard CM, Coyer F. What blood conservation practices are effective at reducing blood sampling volumes and other clinical sequelae in intensive care? A systematic review. *Aust Crit Care*. 2023 Nov;36(6):1129-1137. doi: 10.1016/j.aucc.2022.12.002. Epub 2023 Jan 10. PMID: 36635184.

[11]. Bench, S., 2020. Critical care nurses' views and experiences of pre analytical factors influencing point-of-care testing. *Qual. Stud. Point Care* 19 (4), 97–100.

[12]. Briggs EN, Hawkins DJ, Hodges AM, Monk AM. Small volume vacuum phlebotomy tubes: a controlled before-and-after study of a patient blood management initiative in an Australian adult intensive care unit. *Crit Care Resusc*. 2019 Dec;21(4):251-57. PMID: 31778631.

[13]. Dolman, H.S.; Evans, K.; Zimmerman, L.H.; Lavery, T.; Baylor, A.E.; Wilson, R.F.; Tyburski, J.G. Impact of minimizing diagnostic blood loss in the critically ill. *Surgery* 2015, 158, 1083–1087.

[14]. Bodley T, Chan M, Levi O, et al. Patient harm associated with serial phlebotomy and blood waste in the intensive care unit: A retrospective cohort study. *PLoS One*, 2021;16(1), <https://doi.org/10.1371/journal.pone.0243782>

[15]. Wu, Y.; Spaulding, A.C.; Borkar, S.; Shoaie, M.M.; Mendoza, M.; Grant, R.L.; Barber, B.W.; Johns, G.S.; Franco, P.M. Reducing Blood Loss by Changing Small Volume Tubes for Laboratory Testing. *Mayo Clin. Proc. Innov. Qual. Outcomes* 2021, 5, 72–83.

[16]. Adam, E.H.; Zacharowski, K.; Hintereeder, G.; Zierfuss, F.; Raimann, F.; Meybohm, P. Validation of a New Small-Volume Sodium Citrate Collection Tube for Coagulation Testing in Critically Ill Patients with Coagulopathy. *Clin. Lab*. 2018, 64, 1083–1089.

[17]. Warner, M.A.; Hanson, A.C.; Frank, R.D.; Schulte, P.J.; Go, R.S.; Storlie, C.B.; Kor, D.J. Prevalence of and Recovery from Anemia Following Hospitalization for Critical Illness among Adults. *JAMA Netw. Open* 2020, 3, e2017843.

[18]. Holland J, Peralta RM, Moss RL, Feane K, Uprichard J. A single-centre review of iatrogenic anaemia in adult intensive care. *Transfus Med* 2020;30(3):196-200. <https://doi.org/10.1111/tme.126740>

[19]. HT Lalthanthuami, MJ Kumari, R Venkateswaran, PR Lakshmi, Lakshmi Ramamoorthy, Performance of 3 mL versus 5 mL Discarded Volume for Blood Sampling from Central Venous Access Device, *J Lab Physicians* 2021;13:112–117., DOI <https://doi.org/10.1055/s-0041-1726669>.

[20]. Mackenzie CJ, McGowan CM, Pinchaemoglobineck G, Carlslake haemoglobin. Comparison of two blood sampling techniques for the determination of coagulation parameters in the horse: jugular venipuncture and indwelling intravenous catheter. *Equine Vet J* 2017; 0:1–6

Table 1: Subjects on Blood Loss and Haemoglobin Drop During the Entire ICU Admission. (n=193)

	Blood loss(ml)	Blood loss(%)	Hb drop (%)	Hb drop (g/dl)
Average (Per patient)	87.07	26.2	7.87	1.03
Per day	15.8	4.76	1.43	0.19

Table 2: Correlation of Blood Wastage, Haemoglobin Drop, and PRBC Transfusion Between Invasive Catheter Sampling and Peripheral Puncture Sampling (n=193)

		Invasive catheter blood sampling (119)	Peripheral puncture sampling (74)	p value
Blood wastage (%)	Average (Per patient)	42.52%	0	0.013
	Per day	5.88%	0	
Blood wastage (ml)	Lowest	2 ml	0	
	Average (Per patient)	53 ml	0	
	Highest	315 ml	0	
	Per day	7.325 ml	0	
PRBC Transfusion (units)		63	4	0.034
Hb drop (%)		10.25%	4.04%	
Hb drop (g/dl)		1.37 g/dl	0.5 g/dl	
PRBC Transfusion (units)		63	4	

Table 3: Relationship Between Length of ICU Stay with Blood Loss and Hemoglobin Drop (n=193)

ICU stay	Frequency	days	Blood withdrawn(ml)		Hb drop (%)		Hb drop (g/dl)		p value
			per patient	per day	per patient	per day	per patient	per day	
1- 7 days	148	437	49.09	16.62	5.33	180.75	0.7	0.24	0.021
≥8 days	45	626	211.98	15.23	16.21	116.56	2.13	0.15	0.005

Table 4: Comparison of Blood Sampling Between Invasive Catheter and Peripheral Sampling (n=193)

	Invasive catheter sampling (n=119)		Peripheral sampling (n=74)	
	Frequency	Average per patient	Total	Average per patient
Stat	1186	9.96	246	3.32
Routine	120	1.0	191	2.58
Repeat	73	0.61	13	0.18
No of sampling	2017	16.95	393	5.4

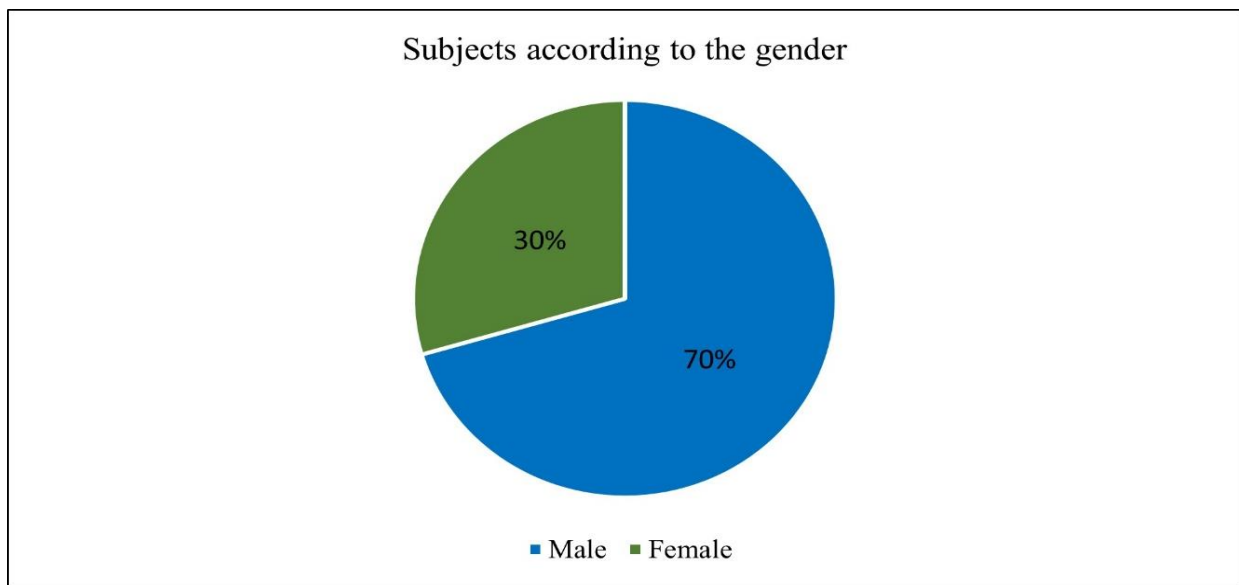


Fig 1: Subjects According to the Gender (n=193)

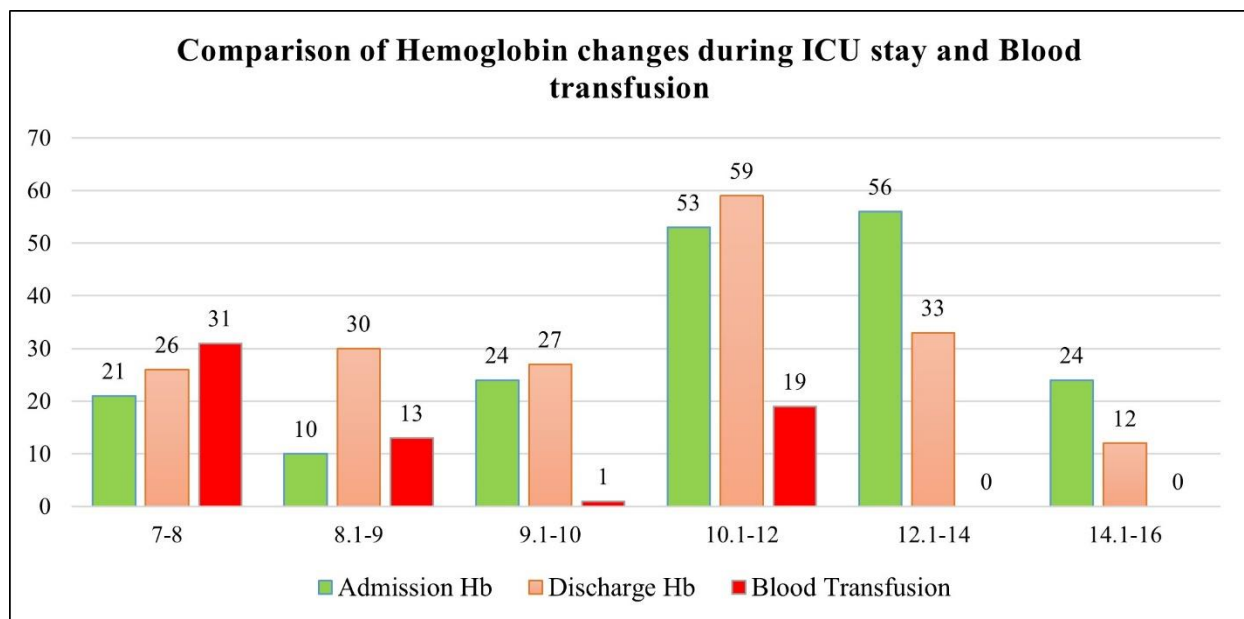


Fig 2: Comparison of Hemoglobin Changes (Admission & Discharge) During ICU Stay and Blood Transfusion (n=193)