



Factors Affecting Nosocomial Anemia in Hospitals among Critically Ill Patients

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ABSTRACT

Background: Nosocomial anemia is a common intensive care unit acquired complications that can lead to poor outcomes and increase morbidity and mortality. Critical care nurses should prevent it by identifying risk factors, minimizing factors contributing to it, using blood conservation strategies, and monitoring oxygen status and hematological one. **Aim:** The study aimed to assess factors affecting nosocomial anemia in hospitals among critically ill patients. **Design:** A descriptive exploratory research design was utilized in this study. **Subjects:** A purposive sample of (110) patients. **Setting:** This study was conducted in the Intensive Care Units at El-Fayoum General Hospital. **Data collection tools:** Tool (I) Patients' structured interview questionnaire: Part (I): Patients' demographic characteristics: Part (II): Patients' health related data. Tool (II): Factors affecting nosocomial anemia assessment Questionnaire: it included four parts: (I): Nutritional and fluid balance-related factors, (II): Drugs-related factors, (III): Sepsis - related factors and part (IV): Blood loss -related factors. Tool (III): Indicators of hospital acquired anemia it included (I): Hemodynamics parameters indicators and (II): Laboratory data. **Results:** The present study illustrated that less than two thirds of the studied patients had anemia on admission while, more than one third of them had nosocomial anemia. **Conclusion:** There was a highly statistically significant relation between the incidence of anemia and demographic characteristics (age, gender, educational level and length of hospital stay) among the studied patients. **Recommendations:** Provide adequate nutritional support considering the quantity and quality of requirements according to patient's condition and availability of dietitian inside critical care unit.

Keywords: Critically Ill Patients, Factors, Nosocomial Anemia.

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INTRODUCTION

Hospitalization has its own hazards. One could have a reaction to a diagnostic or therapeutic procedure; the surgery or procedure could go horribly wrong or one may develop a reaction to drugs or blood administered as part of treatment (Chandrashekar, et al., 2018). Furthermore, iatrogenic factors include all types of medical interventions associated with potential blood loss or factors contributing to impaired erythropoiesis. The impact of iatrogenic anemia was highlighted in the early 1970s as nosocomial anemia but is still a persisting problem (Helmer, et al., 2022).

Anemia is a result of two essential processes in severe sickness and injury: a shorter red blood cell (RBC) circulatory life span and decreased RBC production. Hemolysis, phlebotomy losses, seeping at wounded sites, invasive operations, and gastrointestinal bleeding are some factors that reduce life expectancy. Less than 2% of the blood submitted for analysis by diagnostic phlebotomy in critically sick patients is actually assayed with contemporary laboratory equipment, exceeding the average healthy replacement rate of blood loss of

40 to 70 ml per day (Geetika, et al., 2022).

In addition to increasing the need for allogeneic blood products, anemia is linked to higher rates of complications, longer hospital stays, and higher death rates. A reduction in oxygen-carrying capacity in the face of higher metabolic demands and an increased risk of cardiac-related morbidity and death are two negative effects of anemia (Jandu, et al., 2018).

Nosocomial anemia is hospital-acquired anemia (HAA) that is directly attributable to hospitalization. It is a concept, where in a patient admitted for medical problems experiences a drop in their red cell count due to the hospitalization. Alternatively, it is a reduction of hemoglobin during hospitalization, as compared with the Hb on admission, regardless of the preadmission Hb levels (Noguez, et al., 2018).

Patients in the intensive care unit (ICU) are a diverse population with a wide range of primary diseases and comorbidities. Comorbidities are a factor in the development of evidence-based transfusion trigger recommendations. Blood-saving techniques and point-of-care coagulation disease diagnostics in intensive care unit patients have received special

attention. Red blood cell concentrate administration can be replaced with the administration of intravenous iron and erythropoiesis-stimulating medications as effective and individualized treatments for iron deficient anemia (Neef, et al, 2022).

Critical care nurses (CCN) has a major role in prevention and treatment of this problem. Clinical judgment of nurses should be used to modify routine practice. The primary nursing principles for managing care include minimizing blood loss, maximizing oxygen delivery, attend to patients' nutritional status, assessing the nutritional status, calculating nutritional components requirements based on patient's condition, deciding the timing, the appropriate method for feeding, preventing of feeding method – related complications, and evaluating the response to nutritional support (Asfour, et al., 2017).

As well as CCN plays a crucial role in preventing blood loss during invasive procedures like the insertion of arterial and central venous catheters by monitoring the patient's hemodynamic condition and reviewing any medications they may be taking to treat and prevent HAA in critically ill patients. Despite how severe anemia affects people who are extremely unwell (Ali, et al., 2018).

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SIGNIFICANCE OF THE STUDY

Attention to nosocomial anemia is important because it can impact negatively on critically ill patient, it can lead to increase length of hospital stay, increase mortality rate, increase need for blood transfusion that associated with major complications and decrease in oxygen carrying capacity and plasma volume that are the most significance risks associated with nosocomial anemia in critical ill patients, this decrease in oxygen carrying capacity can result in tissue hypoxia, anaerobic metabolism, production of lactic acid and death (Ali, et al., 2018).

Depending on the number of days in the ICU, the majority of critically ill patients develop anemia. Nosocomial anemia has been associated with increased mortality rate, an increase in length of ICU stay, and the need for blood transfusion they

noted that of all patients admitted to the ICU 76.9 % developed nosocomial anemia and the mortality rate in these patients was as high as 86.7%. More than half of the patients had a length of ICU stay beyond 5 days but < 10 days. However, only 12.3% of patients needed a blood transfusion which could mean that the anemia was mild or went unrecognized (Asfour, et al., 2017).

According to research by (Makam, et al., 2017), 1.4% of hospitalized patients experience a severe case of hospital-acquired anemia, which is indicated by a hematocrit of 27% or less at the time of release, which affects approximately one-third of patients. Anemia is linked to tiredness and poor health-related quality of life (HRQoL) and can last until hospital release and, in some studies, up to six months after ICU discharge.

Nursing care is a very important element of patient care, which plays a pivotal role in the curative as well as rehabilitation process. Furthermore, any lacking in the nursing care process directly affect the patient's health. The world is now facing this problem more frequently than before. Missed nursing issues are increasing day by day and have a direct negative impact on health outcomes (Kalisch, et al., 2019).

AIM OF THE STUDY

The aim of this study was to assess factors affecting nosocomial anemia in hospitals among critically ill patients.

SUBJECTS AND METHODS:

I- Technical item:

The technical item was included research design, setting, subjects and tools for data collection.

Research Design:

Descriptive exploratory research design was utilized to achieve the aim of this study.

Setting:

This study was conducted in the ICUs at El-Fayoum General Hospital at intensive care unit, surgical care unit and stroke unit.

Intensive care units located in the extension "second floor" including 33 nurses and contain 12 beds, the surgical care unit located in the main building "second floor" including 24 nurses and contain 8 beds, and the stroke unit located in the extension "second floor" including 21 nurses and contain 9 bed.

Subjects:

A purposive sample of (110) adult critically ill patients, newly admitted to the intensive care units in the above mentioned sittings was included with the study according to the inclusion criteria **Inclusion criteria:**

Adult patients of both gender, who are conscious and able to communicate verbally, who are free from any bleeding, patients who are not having anemia on

admission, who are not connected with mechanical ventilator and hemoglobin level $>(12)$ g/dl for males and $>(10)$ g/dl for females at admission .

Exclusion criteria:

Patients with bleeding disorder, postoperatively, end stage renal insufficiency or liver disease, malnourished patients before hospital admission and patients on chemotherapy were excluded from the study.

Tools of data collection:

Three tools were utilized to collect data for this study:

This tools were adapted from (Asfour, et al., 2017) and was modified by the investigator based on a review of relevant literature and was written in simple Arabic for data collection.

Tool (I): Patients' structured interview questionnaire:

This tool included two parts:

Part (I): Patients' demographic characteristics:

This part assessed demographic characteristics of the patients included (age, gender, marital status, level of education, occupation, length of hospital stay and place of residence).

Part (II): Patients' health related data:

The investigator recorded laboratory investigations from patients as (hemoglobin, hematocrit level, WBCs and RBCs) for the studied patients from patients files on admission to determine the included patients in this study.

Tool (II): Factors affecting nosocomial anemia assessment Questionnaire:

This tool used to assess factors affecting nosocomial anemia, and it consisted of four parts:

Part (I) Nutritional and fluid balance-related factors:

This tool consisted of two sections:

Section 1: Nutritional- related factors:

-The actual and ideal calorie requirements were recorded after reviewing the hospital dietitian to determine the nutritional status of the studied patients.

-The dietitian calculated the actual calories consumed by patients through identifying type and amount of each oral, enteral or parenteral intake by investigator and converted it into calories to assess nutritional status of each patient according to their disease.

Scoring system

-If the actual nutritional intake was equal the ideal nutritional requirements, it means, that the patient was adequate feeding give (1) degree.

-If the actual nutritional intake was less than the ideal nutritional requirements, it means, that the patient was inadequate feeding give (0) degree.

-If the actual nutritional intake was more than the ideal nutritional requirements, it means, that the patient was over feeding give (2) degree.

Section 2: Fluid balance- related factors:

-The investigator recorded daily fluid intake and

output for each patient from patient sheet to assess patient's hydration status and calculate balance between intakes and output that affect to nosocomial anemia and this factor called hemodilution.

Scoring system

-If patients intake less than output, this called inadequate hydration (hemoconcentration) give (zero) degree

-If patients intake equal output, this called adequate hydration give (1) degree.

-If patient's intake exceeds output, this called (hemodilution) give (2) degree.

Part (II): Drugs-related factors:

-The investigator recorded daily prescribed medication to patient during ICU stay that affects RBCs production or increase RBCs loss such as (cephalosporin, quinolone) investigator record name, dose, frequency of previous drug from patient files.

Scoring system

-If studied patient take any one from previous drug, give yes equal (1) degree.

-Patient who didn't take gives no equal (zero) degree.

Part (III) Sepsis - related factors:

This tool was assess indicators of sepsis for the studied patients from patients' files as temperature, heart rate, blood pressure, WBCs and results of any types of cultures done for patients as (blood, sputum or urine culture).

Part (IV): Blood loss -related factors:

This part was used to estimate blood loss volume during ICU stay. That affects to develop of nosocomial anemia. It consists of three sections:

Section 1: Sampling blood loss volume:

This tool was adopted from (Asfour et al., (2017). It consisted of name of requested investigation, frequency, volume of blood needed, amount of blood with drawn, volume of blood discard, site of blood withdrawn, number of trials each time of withdrawn, calculation of mean blood volume withdrawn per 24 hours assessed and recoded by investigator.

Section 2: Estimation of blood loss volume from puncture site (invasive procedures)

-It was estimated by using gauze visual analogue scale (GVAS).It was adapted from (Algadiem, et al., 2016). The gauze was tested for their absorption capacity. The gauze consisted of three different sizes of commonly used gauze (10x10cm, 30x30cm, 45x45cm).

-Different percentages of stained gauze were estimated for the amount of blood absorbed by the gauze .It was assessed and recorded by the investigator as mild , moderate, and sever soaked of blood according to gauze size.

Section 3: Hematoma measurement scale.

Section 4: Estimation of blood loss volume from gastrointestinal tract.

-It was used to estimate volume of blood loss from gastrointestinal tract (hematemesis or melena), the investigator was assessed and recorded site of bleeding, frequency and associated factors for

bleeding loss volume. The investigator estimated volume of GIT bleeding. The investigator measure oozed are of blood with ruler 0 mark then classified oozing into four categories according to surface area soaked with blood:

- No oozing (dry dressing or linen)
- Mild oozing (<2cm in diameter dressing or linen soaked with blood)
- Moderate oozing (≤ 5 cm in diameter dressing or linen soaked with blood)
- Sever oozing ($5 \leq 10$ cm in diameter dressing or linen soaked with blood)

Tool (III): Indicators of hospital acquired anemia.

Part (I): Hemodynamics parameters indicators

Part (II): Laboratory data

II- Operational Item:

-It was includes preparatory phase, content validity, reliability, pilot study and field work.

A-Preparatory phase:

It was included reviewing of past, current, national and international related literature and theoretical knowledge of various aspects of the study using books, articles, internet, periodicals and magazines to develop tools for data collection. During this phase, the investigator also visited the selected place to get acquainted with the personnel and the study setting. The development of the tools was under the supervisor's guidance and expert's opinions were considered.

B-Tools validity and Reliability:

Validity:

The tools of this study were tested for validity "content validity", it was revised by a panel of 5 experts' of medical surgical nursing from Faculty of Nursing, Helwan University, who reviewed the content of the tools for comprehensiveness, accuracy, clarity, relevance, and minor modifications were done.

Reliability:

Cronbach's Alpha was used to determine the internal reliability of the tool (Hemodynamics parameters indicators & laboratory data). Cronbach's alpha reliability coefficient normally ranges between 0 and 1 with higher value (more than 0.7) denotes acceptable reliability. The tools were written into English as they were filled out by the nurses through a structured interview, and then the reliability of the translated forms of the tools was checked.

C-Pilot study:

The pilot study was done on 10% of the sample (11 patients) collected by the investigator to examine the clarity of questions and time needed to complete the study tools. No modifications were made after analysis of answered questionnaire from nurses, so pilot study sample was included to the total sample.

Field work:

The fieldwork included the following:

- The investigator obtained written consent from the subjects individually after the purpose of the

study was simply explained to the studied conscious patients who agreed to participate with study prior to data collection and an approval was obtained from the director of El-Fayoum General Hospital.

- Data collection was started and completed with six months in the period from the beginning of April 2022 and completed by the end of September 2022.
- Data were collected by the investigator 3 days/week in the morning and afternoon shift in the previous mentioned settings, for newly admitted patient according to inclusion and exclusion criteria for 3 days from admission for non anemic patients until patient become anemic during hospitalization period.
- During night shift the investigator teach and ask for help from staff nurses to observe blood loss and record amount of dietary intake for patients.
- Assessment of patient demographic data, health related data, fluid balance, lab investigation and medications from the patient file took about 30 minutes.
- Assessment of hemodynamic parameter s and estimation of amount of blood loss done by the investigator took about 20 minutes.
- Nutritional status of studied patients assessed by hospital dietitian, the investigator recorded amount and content of patient diet, then the dietitian convert it to calories and determine nutritional status of the studied patients according to their disease.
- Phlebotomy technique done by critically care nurse (CCN) and the investigator estimate amount of blood loss during this procedure.
- The investigator measured hematoma size by putting the rulers 0 at the firm edge of the hematoma and marked it then measured directly across to the opposite firm edge.
- The investigator estimated blood loss associated with invasive procedures by GVAS. The gauze was tested for their absorption capacity and saturation of the gauze by the amount of blood absorbed.

III- Administrative Item:

An official permission was obtained from the general manager of El-Fayoum General Hospital, after issued from the Faculty of Nursing Helwan University explain the aim of the study and obtain the permission for data collection.

ETHICAL CONSIDERATIONS:

An official permission to conduct the proposed study was obtained from the scientific research ethics committee of the Faculty of Nursing at Helwan University. Participation in the study was voluntary and subjects were given full information about the study and their role before signing the informed consent. The ethical considerations included explaining the purpose and nature of the study,

stating the possibility to withdraw at any time, and confidentiality of the information where it couldn't be accessed by any other party without taking permission of the participants. Ethics, values, culture, and beliefs will be respected.

IV- STATISTICAL ITEM:

Data were collected, revised, coded organized, tabulated and analyzed using frequencies, number percentage mean score, standard deviation and correlation coefficient. Data were presented in the

form of tables and figures. Quantitative data was presented by mean (\bar{X}) and standard deviation (SD). Qualitative data was presented in the form of frequency distribution tables, number and percent. It was analyzed by chi-square (χ^2) and correlation to detect the relation between the variable of the study (p-value) Statistical significance of results was considered as follows:

P-values > 0.05 Not significant (NS), P-values ≤ 0.05 Significant (S)

P-values ≥ 0.01 Highly significant (HS).

Results

Part (1): Patients' demographic characteristics:

Table (1): Frequency and percentage distribution of the demographic characteristics among the studied patients (n= 110)

Demographic characteristics		No.	%
Age (year)	18 \leq 30	8	7.3
	31 \leq 40	24	21.8
	41 \leq 50	50	45.5
	51 \leq 60	28	25.5
	Mean \pm SD	45.40 \pm 9.43	
Gender	Male	50	45.5
	Female	60	54.5
Marital status	Single	10	9.1
	Married	68	61.8
	Divorced	12	10.9
	Widow	20	18.2
Occupation	Worker	42	38.2
	Employee	33	30.0
	Not-working	24	21.8
	Retired	11	10.0
Length of hospital stay	1 \leq 2 weeks	36	32.7
	2 \leq 3 weeks	36	32.7
	3 \leq 4 weeks	21	19.1
	\geq one month	17	15.5
		18.75 \pm 7.88	
Place of residence	Rural	45	40.9
	Urban	65	59.1

Table (1): shows that 45.5% of the studied patients' age ranged from 41 \leq 50 with a mean score of 45.40 \pm 9.43. Regarding to gender, 54.5% of them were a females .About two thirds of the studied patients were married, and from urban area with the percentage of (61.8%, and 59.1%) respectively. Regarding to occupation, 38.2% of them working as regard to length of hospital stay 32.7% of them admitted from 1 \leq 3 weeks with a mean score of 18.75 \pm 7.88.

Figure (1): Percentage distribution of the educational level among the studied patients (n= 110)

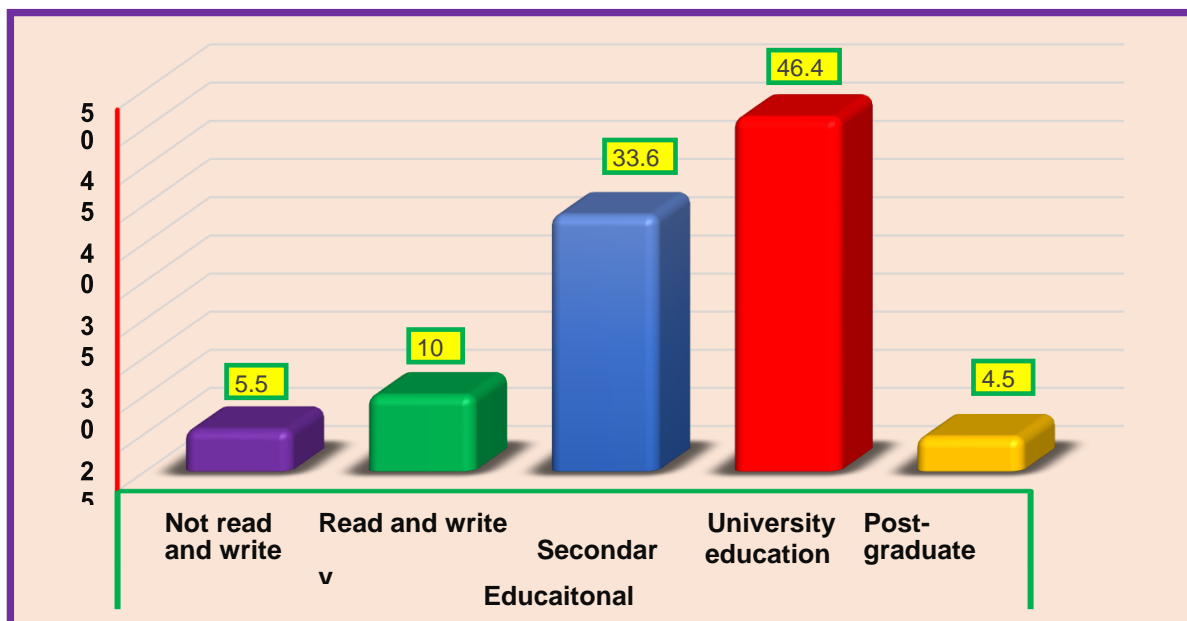


Figure (1): illustrates that, 46.4% of the studied patients have a university education followed by 33.6% of them have secondary school. While, the minority (4.5%) of them have post graduate studies in nursing science.

Part (II): Health related data:

Table (2): frequency and percentage distribution of current medical diagnosis among the studied patients (n= 110)

Current medical diagnosis	No	%
Cardiovascular disorder	11	10.0
Renal disorder	15	13.6
Neurological disorder	15	13.6
Musculoskeletal disorder	14	12.7
Endocrine/metabolic disorder	14	12.7
Gastrointestinal disorder	40	36.4
Respiratory disorder	1	0.9
Total	110	100.0

Table (2): shows that, 36.4% of the studied patients had gastrointestinal disorder, and an equal percentage of 13.6% of them had renal and neurological disorder. Additionally, the studied patients suffered from musculoskeletal

disorder and endocrine disorder with an equal percentage of 12.7%. On the other hand, the minority of them suffered from cardiovascular and respiratory disorder with a percentage of 10% and 0.9% respectively.

Part (III): Factors contributing to hospital acquired anemia assessment tool.**Table (3): frequency and percentage distribution of factors affecting red blood cells production among the studied patient (n= 110)**

Variable		No	%
Nutrition	▪ Adequate	33	30.0
	▪ In- adequate	77	70.0
Route of feeding	▪ Oral	71	64.5
	▪ Enteral	39	35.5
Fluid balance	▪ Hemoconcentration	27	24.5
	▪ Adequate hydration	48	43.6
	▪ Hemodilution	35	31.8
Drug affect red blood cells production	▪ Yes	49	44.5
	▪ No	61	55.5
Affected drug (yes) distributed as (n=49)	▪ Proton pump inhibitor	35	71.4
	▪ Nephrotoxic drugs	14	28.6
Sepsis and presence of infection	▪ Yes	30	27.3
	▪ No	80	72.7

Table (3): represents that 70% of the studied patient had in-adequate nutrition, 31.8% with hemodilution, 27.3% has a sepsis state. Moreover, 44.5 % taking drug that affect red blood cells production; out of this percentage, 71.4 administered proton pump inhibitor and 28.6% taken nephrotoxic drugs

Table (4): frequency and percentage distribution of estimation of sampling blood loss volume among the studied patient (n= 110)

Variable	1 st Day		5 th Day		7 th Day	
	N	%	N	%	N	%
Chemistry						
Number of samplings						
Once	99	90.0	105	94.5	95	86.4
Twice	11	10.0	5	4.5	15	13.6
Amount (mean \pm SD)	2.20 \pm 0.60		2.09 \pm 0.41		2.27 \pm 0.68	
ABG						
Number of samplings						
Once	6	5.5	7	6.4	5	4.5
Twice	4	3.6	5	4.5	5	4.5
None	100	90.9	98	89.1	100	90.9
Amount (mean \pm SD)	2.80 \pm 1.03		2.83 \pm 1.02		3.0 \pm 1.05	
Hematology						
Number of samplings						
Once	100	90.9	99	90.0	93	84.5
Twice	10	9.1	11	10.0	17	15.5
Amount (mean \pm SD)	3.90 \pm 0.28		3.92 \pm 0.29		3.84 \pm 0.36	
Coagulation profile						

Number of samplings						
Once	35	31.8	25	22.7	17	15.5
Twice	10	9.1	8	7.3	5	4.5
None	65	59.1	77	70.0	88	80
Amount (mean \pm SD)	1.83 \pm 0.63		1.86 \pm 0.65		1.84 \pm 0.64	
Total Mean \pm SD	10.30 \pm 1.03		10.33 \pm 1.02		10.5 \pm 1.05	

Table (4): represents that the total mean score of the estimation of sampling blood loss volume among the studied patient= (Mean \pm SD=10.30 \pm 1.03, 10.33 \pm 1.02, 10.5 \pm 1.05) in the 1st day, 5th & 7th respectively.

Table (5): Relation between laboratory investigations and nutritional requirements among the studied patient (n= 110)

Items		Adequate $\bar{x} \pm$ SD	Inadequate $\bar{x} \pm$ SD	T test	P Value
■ Hemoglobin	5 th day	13.37 \pm 1.1	9.49 \pm 1.1	18.5	0.000**
	7th day	13.0 \pm 0.85	9.3 \pm 1.2	17.9	0.000**
■ Hematocrit	5 th day	47.6 \pm 2.38	35.7 \pm 5.18	12.5	0.000**
	7th day	47.97 \pm 1.01	35.0 \pm 5.15	14.3	0.000**
■ RBCs	5 th day	4.79 \pm 0.62	3.47 \pm 0.47	12.1	0.000**
	7th day	4.33 \pm 0.65	3.39 \pm 0.43	8.90	0.000**
■ WBCs	5 th day	7.97 \pm 2.41	9.72 \pm 4.30	2.2.	0.030*
	7th day	8.69 \pm 2.0	10.83 \pm 4.62	2.15	0.033*
■ Albumin	5 th day	4.7 \pm 0.62	3.67 \pm 0.54	8.90	0.000**
	7th day	4.61 \pm 0.58	3.59 \pm 0.66	7.70	0.000**

*Significant $p \leq 0.05$

**Highly significant $p \leq 0.01$

Table (5): represents that, during 5th and 7th day post admission patients with in-adequate nutritional requirements had a lower mean score of hemoglobin, hematocrit, RBCs, and albumin (9.49 \pm 1.1, 9.3 \pm 1.2 & 35.7 \pm 5.18, 35.0 \pm 5.15 & 3.47 \pm 0.47, 3.39 \pm 0.43 & 3.67 \pm 0.54, 3.59 \pm 0.66) respectively. While WBCs gained higher mean

score (9.72 \pm 4.30, 10.83 \pm 4.62) during 5th and 7th day post admission. Moreover, it shows that that there was a highly statistically significant relation between laboratory investigations (hemoglobin, hematocrit, RBCs, WBCs and albumin) and nutritional requirements among the studied patient at P ranged from 0.033 to 0.000.

Table (6): Relation between incidence of anemia and demographic data among the studied patients (n= 110)

Items		Total anemic level				χ^2	P-Value
		Anemic		Not-anemic			
		74 N	67.3 %	36 N	32.7 %		
Age	18 \leq 30	2	1.8	6	5.5	42.2	0.000**
	31 \leq 40	5	4.5	19	17.3		
	41 \leq 50	43	39.1	7	6.4		
	51 \leq 60	24	21.8	4	3.6		
Gender	Male	29	26.4	21	19.1	3.58	0.05*
	Female	45	40.9	15	13.6		
Educational level	Not read and write	2	1.8	4	3.6	14.4	0.014**
	Read and write	4	3.6	7	6.4		
	Secondary school	29	26.4	8	7.3		
	University education	34	30.9	17	15.5		
	Post-graduate	5	4.5	0	0.0		
Occupation	Worker	24	21.8	18	16.4		

	Employee	26	23.6	7	6.4	4.1	0.251
	Not-worker	16	14.5	8	7.3		
	Retired	8	7.3	3	2.7		
length of Hospital stay	1 ≤ 2 weeks	3	2.7	33	30.0	85.0	0.000**
	2 ≤ 3 weeks	33	30.0	3	2.7		
	3 ≤ 4 weeks	21	19.1	0	0.0		
	≥ one month	17	15.5	0	0.0		

*Significant $p \leq 0.05$; **Highly significant $p \leq 0.01$

Table (6): shows that there were a highly statistically significant relations between the incidence of anemia and demographic data (age, educational level, and length of hospital stay) among the studied patients, with a P value 0.000**. In relation to gender, there was statistically significant relation between gender and incidence of anemia with a P value 0.05.

DISCUSSION

Nosocomial anemia is considered a frequent complication experienced by critically ill patients. There are two main factors that contribute to nosocomial anemia in critically ill patients: RBCs loss and insufficient production of RBCs. Loss of RBCs can be therapeutic in the form of sampling, insertional blood loss and drugs associated with bleeding complications and situational one. Decrease RBCs production can be caused by nutritional deficiencies, erythropoietin impairment and drugs that may suppress bone marrow activity (Shander & Corwin, 2020)

Regarding to Patients' demographic characteristics:

The studied patients, the current study result showed that less than half of the studied patients age ranged from $41 \leq 50$ with a mean score of 45.40 ± 9.43 . This result was contrasted with (Juárez-Vela, et al., 2022) who found that a median age of 58 years. This result could be due to most of critically ill patients were old age due to critical illness and chronic disease affect old age more than young age.

Regarding to gender, more than half of them were a females. This result was in accordance with (Wu, et al., 2022) who revealed that highly percentage of the studied patients were females. This result could be due to female gender risk for anemia more than male due to pregnancy, labor, breast feeding and menstrual disorder

According to marital status, less than two thirds of the studied patients were married, less than two fifths of them were workers and more than half of them from urban area. In accordance with (Taderegew, et al., 2020) study who found that more than two thirds of the studied patients were married, highly percentage of them were from urban areas while more than two fifths of them were government employee. From the investigator

point of view this might be related to Elfayoum general hospital serve all cases all over Egypt areas

As regarding to length of hospital stay, about two thirds of them length of hospital stay ranged from 1 to 3 weeks with a mean score of $18.75 + 7.88$. In disagreement with (Villani, et al., 2023) who illustrated that the median length of hospital stay was 9 days (IQR 5–13 days). Also contrasted with (Czempik, et al., 2022) in a retrospective Cohort Study who showed that a mean score of length of stay, [days] 3.0–14.0 This result could be due to critical patients' health condition.

Regarding educational level among the studied patients, the current study result showed that less than half of the studied patients had a university education followed by one third of them had secondary school. While the minority of them was illiterate. In contrasted with (Taderegew, et al., 2020) who showed that more than one quarter of them had higher education, while more than one quarter was illiterate. This result could be due to critical patients' from urban area which attention to educational level.

In relation to Health related data, Concerning current medical diagnosis among the studied patients, the current study result showed that, more than one third of the studied patients had gastrointestinal disorder, more than one tenth of them had neurological disorder and renal disorder, and suffered of musculoskeletal disorder and endocrine disorder respectively. On other hand, the minority of them suffered of cardiovascular and respiratory disorder respectively.

This result in the same line with (Villani, et al., 2023) who found that low percentage of the studied patients suffered of cardiac diseases. While on the same hand, (Warner, et al., 2020) Who reported that, most articles addressing the topic of new-onset anemia in hospitalized patients have been performed in critical ill populations admitted to intensive care units or patients hospitalized for acute myocardial infarction. This result may be due to family medical history and the studied sample old age which association with chronic diseases.

As regards to Factors contributing to hospital acquired anemia, factors affect red blood cells production among the studied patient, the current study result, represented that less than three quarters of the studied patient had in-adequate

nutrition, less than one third of them with hemodilution, more than one quarter of them had sepsis state. Moreover, more than two fifths of them taking drug that affect red blood cells production; out of this percentage, less than three quarters of them administered proton pump inhibitor and more than one quarter of them taken nephrotoxic drugs.

these findings approved in a study done by (Salah & Mohamed, 2018) who found that, more than three quarter of the studied anemic patients had inadequate feeding, while more than half of non-anemic studied patients had inadequate feeding. While more than two third of the studied anemic patients took drugs that affect red blood cells production, while less than one quarter of non-anemic studied patients took this drugs, but the majority of the studied patients took this drugs, Proton pump inhibitors (PPI) drugs considered the most drugs was taken by anemic patients (more than two quarters of anemic patients were taken proton pump inhibitor), and more than three quarters of non -anemic patients were taken PPI, followed by nephrotoxic drugs (nearly one third of the studied patients were took nephrotoxic drugs) had Hospital Acquired Anemia (HAA).

The study results are consistent with (El-Soussi, et al., 2016) who showed that most of them had nutritional defecte, administered proton pump inhibitor respectively. Less than three quarters of them taken nephrotoxic drugs. As regard drug that affect red blood cells production 80% most of them taken Non-steroidal anti-inflammatory drugs (NSAIDs), more than three quarters of them taken anticoagulants .

This findings could be attributed to many reasons as; policy of general ICU in study setting indicated that any admitted patients must take prophylactic PPI against stress peptic ulcer and prophylactic antibiotic against hospital acquired infection

This result in the same line with (Jiang, et al., 2019) and found that the studied patient had anemia in the 3 and 7 day of ICU admission. While In the other hand with (Warner, et al., 2022) who found that more than half of the studied patients were anemic within 24 hours of ICU admission. This could be due to the studied critically ill patients were exposed to multiple iatrogenic factors (diagnostic/therapeutic interventions) during their ICU stay; which induced a decrease in the quantity and quality of the circulating hemoglobin.

Regarding to indicators of hospital acquired anemia, the laboratory investigation during the three different assessment period among the studied patients, the current study result represents that on admission; more than half of them had a normal range of hemoglobin, hematocrit, RBCs respectively, the majority of them had a normal range of WBCs and less than three quarters of them

had had a normal range of albumin. While in 5th and 7th day post admission;the majority of these labs (hemoglobin, hematocrit and RBCs) were in lower rang among two thirds of the studied patients respectively. There were a highly statistically differences between total level of laboratory investigation (hemoglobin, hematocrit, RBCs, and WBCs) during the three different assessment period among the studied patients P value ranged between 0.007 to 0.001.

This result was supported with (Elmetwalli, et al., 2021) who showed that there are statistically significant differences in all mean laboratory readings except HDLC and T4. And the baseline means reading was 13.4 ± 1.3 g/dl, while the seventh-day reading was 10.4 ± 0.1 g/dl. It was noticed that the level of hemoglobin decline from the baseline observation to the seventh-day of admission.

Moreover, there was a highly statistically significant relation between laboratory investigations (hemoglobin, hematocrit, RBCs and WBCs) and nutritional requirements among the studied patient at P ranged from 0.033 to 0.000.

This result contrasted with (Czempik, et al., 2022) there were no differences in Hb changes during ICU hospitalization.

This result may be due to nutritional requirements affect on hemoglobin, hematocrit, RBCs and WBCs among the studied patients

Concerning to 5th and 7th day post admission patients with enteral feeding had a lower mean score of hemoglobin, hematocrit and RBCs ($10.12 + 2.26$, $9.65 + 2.0$ & $36.59 + 6.34$, $35.5 + 5.67$ & $3.53 + 0.77$ & $3.42 + 0.63$, $3.72 + 0.71$ & $3.60 + 0.78$) respectively. While WBCs gained a higher mean score ($12.28 + 4.58$, $12.41 + 5.30$) during 5th and 7th day post admission.. Moreover, there was a highly statistically significant relation between laboratory investigations (hemoglobin, hematocrit, RBCs and WBCs) and route of feeding among the studied patient at P ranged from 0.004 to 0.000. In the same line with (Salah & Mohamed, 2018) who found that there was asignificant relation between inadequate feeding and occurrence of HAA. This result may be due to different routes of feeding with long stay in the hospital can cause various complication and side effects.

CONCLUSION

In the light of the current study findings, it can be concluded that,

About three quarters of the studied patients suffered from anemia, less than half of them had anemia on admission, while less than one third of them had nosocomial anemia in hospital, and about one third of the studied patients had anemia on the 5th day of admission to the hospital. In addition, nearly three quarters of the studied patients had

inadequate nutrition; and about one third of them had hemodilution. Moreover, more than two fifths of them not take drugs that affect red blood cell production, and highest group of the studied patients had sepsis.

RECOMMENDATIONS

Based upon the results of the current study, the following:

Recommendation for clinical practice:

- It recommended that health care settings should provide adequate nutritional support considering the quantity and quality of requirements according to patient's condition and availability of dietitian inside critical care unit.
- Encourage collaboration between nurses and pharmacists to increase nurses' awareness regarding drugs side effects especially hematological side effects.

Recommendation for Education:

- Provide continuous in- service educational programs and scientific courses for critical care nurses to revise, acquire and develop knowledge and performance regarding to risk factors, etiology and preventive measures of nosocomial anemia.

Recommendation for further research:

- Develop standards for blood conservation strategies and standards for nutrition requirement for critically ill patients are highly recommended to maintain optimal health for such group of patients.
- The study should be replicated on large sample and in different hospitals setting in order to generalize the results.

REFERENCES:

- Algadiem, E., Aleisa, A., Alsubaie, H., Buhlaiah, N., Algadeeb, J. & Alseini, Ali, H.A., Hassan, M.S and EL- Metwaly, R.M.(2018):** Factors Contributing to Hospital Acquired Anemia among Critical Ill Patients. *Egyptian Journal of Health Care, EJHC* Vol.9 No.4 EJHC 394
- Asfour, H., EL-Soussi, A., and Reffat, F. (2017):** Factors contributing to nosocomial anemia in the critical ill patient; *IOSR Journal of Nursing and Health Science (IOSR-JNHS)*, Vol.5, NO (1), PP.31-44 Available at www.iosrjournals.org.
- Chandrashekar. (2018):** Hospital-Acquired Anemia: A Hazard of Hospitalization, *Global Journal of Transfusion Medicine AATM* | Volume 3 | Issue 2: IP: 41.176.50.218 Available at:
- <http://www.gjtmonline.com>
- Czempik, P. F., Wilczek, D., Herzyk, J., and Krzych, L. J. (2022):** Hospital-Acquired Anemia in Patients Hospitalized in the Intensive Care Unit: A Retrospective Cohort Study. *Journal of Clinical Medicine*, 11(14), 3939.
- Elmetwalli, M., Khalil, N., & Reshia, F. (2021):** Correlation between Phlebotomy Blood Loss and Hospital-Acquired Anemia among Acute Coronary Syndrome Patients. *Mansoura Nursing Journal*, 8(2), 59-75.
- El-Soussi, A. H., Asfour, H. I., & Raffat, F. A. (2016):** Factors contributing to nosocomial anemia in the critically ill patients. *IOSR Journal of Nursing and Health Science*, 5(1), 31-44.
- Geetika, G., Anjum, H., and Reddy, R.J. (2022):** Role of Anemia as An Etiological Factor And Prbc Transfusion As A Preventive Measure Among Critically Ill Patients And Its Contribution to ICU Related Morbidity. Volume - 11 | Issue - 02 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
- Helmer, P., Hottenrott, S., and Steinisch, A. (2022):** Avoidable Blood Loss in Critical Care and Patient Blood Management: Scoping Review of Diagnostic Blood Loss, *J. Clin. Med.*, 11, 320. <https://doi.org/10.3390/jcm11020320>
- Jandu,A.S., Vidgeon, S., and Ahmed, N. (2018):** Anaemia and transfusion triggers in critically ill patients – What we have learnt thus far, *Journal of the Intensive Care Society*, Vol. 20 (4) 284–289. Available at: sagepub.com/journals-permissions DOI: [10.1177/1751143718783615](https://doi.org/10.1177/1751143718783615)
- Jiang, Y., Jiang, F. Q., Kong, F., An, M. M., Jin, B. B., Cao, D., & Gong, P. (2019):** Inflammatory anemia-associated parameters are related to 28-day mortality in patients with sepsis admitted to the ICU: a preliminary observational study. *Annals of intensive care*, 9, 1-11.
- Juárez-Vela, R., Andrés-Esteban, E.M., and Gea-Caballero, V. (2022):** Related Factors of Anemia in Critically Ill Patients: A Prospective Multicenter Study, *J. Clin. Med.*, 11, 1031. <https://doi.org/10.3390/jcm11041031>
- Kalisch BJ, Lee KH.(2019);** The impact of teamwork on missed nursing care. *Nurs Outlook* [Internet]. 2010 [cited 2019 Oct

- 1];58(5):233–41.
Available:<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4988676>
- Makam AN, Nguyen OK, Clark C, and Halm EA. (2017):** Incidence, predictors, and outcomes of hospital acquired anemia. *J Hosp Med*; 12:317-22.
- Neef, V.M., Blum, L.M., and Hof,L. (2022):** Patient blood management in the ICU A narrative review of the literature, *Eur J Anaesthesiol Intensive Care Med*; 1:2(e002)Available at: [DOI:10.1097/EA9.0000000000000002](https://doi.org/10.1097/EA9.0000000000000002)
- Noguez J. (2018);**Tackling Hospital-Acquired Anemia. Available from: <https://www.aacc.org/publications/cln/articles/2016/april/tackling-hospital-acquired-anemia-lab-based-interventions-to-reduce-diagnostic-blood-loss>
- Salah Hassan, M., & Mohamed El-Metwaly, R. (2018):** Factors Contributing to Hospital Acquired Anemia among Critical Ill Patients. *Egyptian Journal of Health Care*, 9(4), 394-414.
- Shander, A., & Corwin, H. L. (2020):** A narrative review on hospital-acquired anemia: keeping blood where it belongs. *Transfusion Medicine Reviews*, 34(3), 195-199.
- Taderegew, M.M., Gebremariam, T., Tareke, A.A., and Woldeamanuel, G.G. (2020):** Anemia and Its Associated Factors Among Type 2 Diabetes Mellitus Patients Attending Debre Berhan Referral Hospital, North-East Ethiopia: A Cross-Sectional Study. *J Blood Med*. 47-58. Available at: [Doi: 10.2147/JBM.S243234](https://doi.org/10.2147/JBM.S243234). [PMID: 32104127](https://pubmed.ncbi.nlm.nih.gov/32104127/); [PMCID: PMC7023873](https://pubmed.ncbi.nlm.nih.gov/PMC7023873/).
- Villani, R., Romano, A. D., Rinaldi, R., Sangineto, M., Santoliquido, M., Cassano, T., & Serviddio, G. (2023):** Prevalence and risk factors for hospital-acquired anemia in internal medicine patients: learning from the “less is more” perspective. *Internal and Emergency Medicine*, 18(1), 177-183 .
- Warner MA, Hanson AC, Frank RD, Schulte PJ, Go RS, Storlie CB, Kor DJ (2020)** :Prevalence of and recovery from anemia following hospitalization for critical illness among adults. *JAMA Netw Open* 3(9):e2017843. <https://doi.org/10.1001/jamanetworkopen.2020.17843>
- Wu, Y. H., Wu, Y. C., Chang, J. Y. F., Lang, M. J., Chiang, C. P., & Sun, A. (2022):** Anemia, hematinic deficiencies, and hyperhomocysteinemia in younger and older burning mouth syndrome patients. *Journal of Dental Sciences*, 17(3), 1144-1150.