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Incidence of Central Line-Associated Bloodstream Infections (CLA-BSIs) in the Intensive Care Unit (ICU) at Benghazi Medical Centre

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ABSTRACT

Critically ill hospitalized patients have a significant risk of developing nosocomial bloodstream infections; most of these BSIs are usually from an intravascular device, Central-line-associated bloodstream infection is one of the most important problems in intensive care units worldwide. The study aimed to measure the incidence, risk factors, and most frequent causative organisms of central line-associated bloodstream infections in the Medical Intensive Care Units at Benghazi Medical Centre. This prospective study included 124 patients and was conducted between September 2021 and February 2022 in the Medical Intensive Care Units at Benghazi Medical Centre. The data was collected by using two research tools, worksheet for recording the data on each ICU patient with a central line and blood samples collected from patients using strict aseptic technique and sterile equipment. The total incidence rate of CLA-BSI in internal Intensive Care Units at Benghazi Medical Centre was 12.4/1000 CL-days, and the infection rate of CLA-BSI in patients' blood cultures after CVC insertion was 11.3%. Gram-negative bacteria were the most causative microorganisms by 54.4%, and 45.6% of the infection was gram-positive bacteria. *Klebsiella pneumoniae* was the most causative microorganism in gram-negative bacteria by 35%. While 28.1% of gram-positive bacteria were *Staphylococcus aureus*. *Klebsiella pneumoniae* and *Staphylococcus epidermidis* reported resistance to most of the tested antibiotics. CLA-BSI is an important cause of mortality in ICU patients. Patients with CLABSIs can have a longer hospital stay and higher health care costs. Thus, implementing standard infection prevention practices for critically ill patients is highly recommended.

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1. Introduction

Critically ill hospitalized patients have a significant risk of developing a nosocomial bloodstream infection (BSI); most of these BSIs are primary and usually originate from an intravascular device. Central venous catheters (CVCs) are commonly used in intensive care units (ICUs). Yet, insertion a catheter can pose a risk of infections to patients caused by complications that can lead to death. Infections risks consist of femoral or internal jugular rather than subclavian catheterization; paying no attention to sterile barrier precautions during catheterization; not using personal protective equipment including a mask, sterile gown, sterile gloves(1).

The International Nosocomial Infection Control Consortium (INICC) reported that Central line-associated bloodstream infection (CLABSI) rates in intensive care units (ICUs) of developing countries are higher than in the developed world. It is stated that the pooled rate of CLA-BSI in the INICC's ICUs of Latin America, Asia, Africa, and Europe, 4.9 per 1000 central line days, is nearly 5-fold higher than the rate reported from comparable US ICUs included in their last report. Actually, out of all kinds of hospital acquired infections, CLA-BSIs have the highest mortality rate ranging from 12% to 25%. Patients with CLA-BSIs can experience longer hospital stay, higher health care costs and attributable mortality(2)(3).

Each year, hundreds of millions of patients are affected by Healthcare-Acquired Infections (HAIs) throughout the world(4). These infections can significantly increase morbidity and mortality in developed and developing countries(5). Seriously ill patients are mainly susceptible to serious complications as a result of HAIs, expected risk factors including progressively more invasive medical technology and complex medical procedures, increasing immunocompromised status and old age, chronic diseases, length of stay at hospital, and the increasing incidence of antimicrobial resistance(6). In the United States, the CDC estimates that 5% to 10% of hospitalized patients can develop HAI(7). CLA-BSI is the most common cause of HAI in the blood-stream, an estimated 250,000 bloodstream infections happen every year, and most are associated to the presence of intravascular devices(8). CLA-BSIs are serious but can often be prevented when evidence-based guidelines are tracked for the insertion and maintenance of central lines. Following Infection control guidelines can significantly decrease the risk of infection and mortality in patients(9). In developing countries, mortality rates may be as high as 50%(6). For instance, a study in Egypt was conducted in the ICUs of 3 hospitals at Cairo University, and CLA-BSI rates varied widely, from 2.9 to 14.3 per 1,000 central line-days, with an overall rate of 9.1/1,000 central line-days(10). Also a study in Libya conducted in Al Jumhoria hospital over a period of 24 month (2009-2010) on 937 patients, who developed BSIs were admitted to different medical units of the hospital including Coronary care units (CCU), isolation units (ISO), neurological units (B.C), Medicine units (B.B), intensive care units (ICU), gynecology units (G.B), oncology units and hematology units (B.A). It has been found that the rate of BSIs in 2009 was (28%), while the rate of infection in 2010 was (27%) with the highest percentages (61%) in ICU in 2009, however in 2010 the infection rate was lower (52.5%). This study also showed methicillin resistant S. aureus (MRSA) represented (5.7%) from all bacterial isolates tested. However, methicillin resistant coagulase negative Staphylococci occurred high percentage (27.4%) than MRSA(11).

Available statistics on the global impact of CLA-BSIs have been more restricted, mainly in many resource-constrained areas. Low- and middle-income countries usually do not have adequate resources to conduct CLABSI investigation and lack continuous improvement strategies for optimal patient care. Researchers who have attempted to quantify CLABSI rates in developing countries have found these rates to be much higher than those in developed countries, and their impact on patients and health care delivery systems is both severe and undervalued(12).

This study aimed to measure the incidence, risk factors and most frequent causative organisms of central line-associated bloodstream

infections (CLA-BSI) in the Internal (Medical) Intensive Care Units (ICUs) at Benghazi Medical Centre (BMC), Benghazi, Libya.

2. Methodology

2.1 Study Design

A prospective cohort study was conducted in which all patients admitted for more than 48 hours between September 2021 to February 2022 to Internal (Medical) ICU of Benghazi Medical Centre (BMC) were monitored for the occurrence of CLA-BSI. The study population was 124 cases out of 1100.

2.2 Study Population

The infection surveillance cohort consisted of all patients admitted to the medical ICUs who had central venous lines for at least 48 hours (3). The infection surveillance was carried out over a period of 6 months from September 2021 to February 2022.

2.3 Study Tools:

2.3.1 Work sheet:

This sheet was used to collect the data on each ICU patient with a central line including:

a-Administrative data: patient's name, medical record number, hospital admission date, ICU admission date and discharge date.

b- Demographic data: Gender, age, medical history and co-morbidities.

c-Admission diagnosis: for instance, Chronic Obstructive Pulmonary Disease (COPD), liver cell failure, heart failure, immuno-compromised state, end-stage renal disease, Diabetes Mellitus (DM), hypertension, neurodevelopmental problems. smoking, and chronic.

d- Data about Insertion devices: Type of catheter, insertion site, duration of catheter placement, hospitalization days before ICU admission, length of stay, previous hospitalization, inserted medical devices at admission, repeated central line insertion during the same ICU admission.

e- Central Line-Associated Bloodstream Infection (CLA-BSI) criteria: Date of suspected CLA-BSI, symptoms [e.g: fever, chills and hypotension] and laboratory criteria.

f-Outcome of stay in the ICU: e.g: discharge, death, transfer to another ward or transfer to another hospital.

2.3.2 Blood Tests:

Blood cultures and sensitivity were collected from ICU patients, who have any signs of manifestations of sepsis or incidence of central line-associated bloodstream infection (CLA-BSI). Blood samples collected using strict aseptic technique and sterile equipment, were inoculated into blood culture bottles that promotes the growth of aerobic and anaerobic microorganisms.

2.4 Inclusion Criteria:

All ICU patients with a central venous catheter in the hospital had no infection at the time of admission.

2.5. Exclusion Criteria:

- Patients who died or were discharged within 48 hours of admission.
- Patients without a central venous line were excluded.

2.6 Data analysis:

1. Worksheet: data quantitatively analyzed the Statistical Package for Social Sciences (SPSS), and presented in simple frequency tables, and chart were used in data presentation to provide visual simplicity for presented data. A chi-square test was used to compare quantitative data between groups, The adjusted risk factors for CLA-BSI were obtained using the logistic regression analysis. The dependent variable was the presence or absence of CLA-BSI in all the patients. A p-value < 0.05 was considered as a significance.

2. Steps for calculating the central line-associated bloodstream infection/central venous catheter-related BSI rate: All patients admitted to Internal ICU were daily monitored by physicians' round for the development of nosocomial BSI, which was required to meet at least one of the following criteria:

First Criteria: Patient has a predictable pathogen cultured from blood cultures and the organism cultured from blood is not related to an infection at another site.

Second Criteria: Patient has at least one of the following signs or symptoms: fever (> 38°C), chills, or hypotension (3).

The signs and symptoms of infection appear 48 hours after admission, and there are no signs or symptoms of infection at the time of admission, demonstrated by the patient's history and clinical examination.

Incidence rate also known as incidence density rate, is determined by taking the total number of new cases of an event/cases and dividing that by the sum of the person-time of risk population.

$$\text{CLA-BSI incidence rate} = \frac{\text{No. of CLA-BSI Cases}}{\text{No. of central line days}} \times 1000$$

3. Specimen's laboratory analysis: blood cultures and sensitivity were analyzed in specialized laboratory Al-Akeed which is certified by National Centre for Disease Control Libya. All bacterial isolates were stained using Gram staining technique to differentiate between Gram negative or Gram positive. Culture media used were blood Agar, Chocolate Agar, MacConkey Agar.

2.6 Ethical considerations:

There were no ethical issues and this study was conducted after submitting an official application paper from Benghazi Medical University to BMC Hospital and it was officially approved for data collection and sampling from patients. Data were coded, and the anonymity of the data was maintained during the statistical analysis.

3. Results

Overall, 1100 patients were admitted to the internal ICU in the follow-up period (6 months); 52% of all the patients admitted had CVC insertion (572 patients).

The age categories of the studied patients ranged from 18-92 years (mean ± SD was 58.2 ± 14.6 years), the median hospital stay before ICU admission was 2 days, and the median ICU stay was 5 days.

The total incidence rate of CLA-BSI in internal ICU at BMC during period from (September 2021 to February 2022) was 12.4/1000 CL-days, the infection rate of CLA-BSI patients' blood cultures after CVC insertion was 11.3%.

Table 1 shows risk factors for Central Line Associated Bloodstream Infection CLA-BSI among the Intensive Care Unit ICU patients during the period from September 2021 to February 2022. 75% of patients were male and the rest were female; specifically, 44.0% of all male patients admitted had infected while 49.0% of all female patients admitted had infected.

The p-value of this case was not significant and out of range by 0.09. Also, the p-values for previous hospitalization, COPD, Liver failure, Heart failure, Immunosuppression, and Neurological disease patients were non-significant and were in the range (0.3 to 0.9) which is mean low severity of CLA-BSI occurrence for all these patients.

Finally, higher risk factors and severity of occurrence of CLA-BSI were observed with Renal failure, DM, and Hypertension, where the p-values were 0.01, 0.02, and 0.03, respectively.

Table 2 shows relationships between ICU length of stay and the occurrence of CLA-BSI in patients. It was one of risk factors that increase infection rate of CLABSI long stay in ICU >5days with significant value 0.04. The central venous line also had higher risk factor for rise rate of CAL-BSI (57%) than other inserted medical devices with significant p-value 0.03. Also one of risk factors was insertion CVC site. Subclavian insertion of a CVC has high infection rate of CLA-BSI (14%) compared with other sites of CVC insertion with significant p-value 0.02.

Table 3 shows the multivariate logistic regression model analysis of risk factors for CLA-BSI in ICU patients, ICU stay of 5 days or more, renal failure, DM, hypertension, and CVC.

Table 1: Risk factors for CLA-BSI among ICU patients from (September 2021 to February 2022) (n= 124)

Variables	Infection No.%	No Infection No.%	Chi-square	P-value (P< 0.05)
Gender			0.5	0.09
Male (n=75)	33 (44)	42 (56)		
Females (n=49)	24 (49)	25 (51)		
Previous hospitalization (n=14)	8 (57)	6 (43)	0.4	0.3
COPD*(n=12)	5 (42)	7 (58)	0.004	0.8
Liver failure (n=17)	1(6)	16 (94)	0.2	0.6
Heart failure (n=42)	2 (9)	40 (91)	0.1	0.7
Immunosuppression (n=7)	2 (29)	5 (71)	0.002	0.9
Renal failure (n=48)	5 (10)	43 (90)	6.3	0.01*
DM (n=43)**	23 (53)	20 (47)	4.9	0.02*
Hypertension (n=19)	5 (26)	14 (74)	3.4	0.03*
Neurological disease (n=3)	1(33)	2 (67)	0.002	0.9

*No.:Number, *COPD: Coronary Obstructive Pulmonary Disease; **DM: Diabetes Mellitus

Table 2: Relationships between ICU length of stay and the occurrence of CLA-BSI in patients

Variable	Infection No. %	No Infection No. %	Chi-square	P-value < 0.05
ICU length of stay				
< 5 days (n=39)	13 (33)	26 (67)	3.6	0.04*
>5days (n=85)	44 (52)	41 (48)		
Inserted Medical devices				
Urinary catheter (n=25)	9 (36)	16 (64)	1.0	0.3
Central venous line (n=92)	52 (57)	38 (41)	3.2	0.03*
Mechanical Ventilation (n=7)	2 (29)	5 (10)	0.3	0.5
Site of CVC Insertion				
Jugular (n=107)	5 (5)	102 (95)		
Subclavian (n=14)	2 (14)	12 (86)	2.9	0.02*
Femoral (n=3)	1 (33)	2 (67)		
Place od Admission	-	-		
Unknown (n=0)	1 (20)	4 (80)	1.2	0.3
Other hospital (n=5)	13 (43)	17 (57)		
Same hospital (n=30)	3 (4)	85 (96)		
Home (n=89)				

Table 3: Logistic Regression Model Analysis of Risk Factors for CLA-BSI in ICU patients

Variable	No. of cases with risk factor/ all participants	No. of cases with risk factor/ all cases with CLA-BSI	P-Value <0.5	Odds Ratio	95% Confidence Interval
ICU stay of at least 5 days	44/57	85/124	0.002	5.9	1.6 – 14.6
Renal Failure	5/57	48/124	0.04	2.3	1.1 -9.6
DM*	23/57	43/124	0.02	4.2	1.2- 12.6
Hypertension	5/57	19/124	0.03	3.4	1.0 – 11.4
CVC*	52/57	92/124	0.001	6.3	2.1 – 16.3

*No.:Number, *CVC: Central Venous Catheter; **DM: Diabetes Mellitus.

The total participants were 57, and the highest risk factors were associated with CVC, ICU stay of at least 5 days, and DM cases with a total of 52, 44, and 23 respectively. However, only 10 cases were reported with renal failure, and hypertension. Regarding the CLA-BSI cases,

there were a total of 124 patients and the highest risk factors were associated with CVC, ICU stay of at least 5 days, renal failure, and DM cases with number of cases 92, 85, 48 and 43 respectively, while only 19 were reported with hypertension.

Overall, the P-Values for the variable's ICU Stay of at least 5 days, renal failure, DM, hypertension, and CVC were significant with values 0.002, 0.04, 0.02, 0.04, and 0.001 respectively. The outcome of admitted patients, (94) 75.8% were discharged to the same hospital, (7) 5.7% were discharged to another hospital, (9) 7.2% were discharged home, and (14)11.3% of the patients died.

In Figure 1 *Staphylococcus aureus* showing methicillin resistance character against Oxacillin (Oxacillin resistance MRSA).

Figur 2 shows the distribution of the microorganisms identified in patients' blood culture after CVC insertion. The identified bacteria were *Klebsiella pneumoniae* approximately 20 (36.1%), *staphylococcus aureus* approximately 16 (28.1%), *Enterobacter spp* 11 (19.3%), *Staphylococcus Epidermidis* 10 (17.5%). Thus, 54.4% infection was caused by gram negative bacteria, while 45.6% of the infection was caused in in gram positive bacteria.

Table 4 shows distribution of gram- negative isolates according to susceptibility to antimicrobials agents. Most isolates of *K. pneumoniae* were 100% resistant to most antibiotic. However, the result of antibiotic sensitivity testing showed that K. pneumoniae isolate was sensitive to colistin, doxycycline and levofloxacin respectively. *Enterobacter Spp* also were resistance to most of antibiotic except Ciprofloxacin, Amikacin, Vancomycin, and Oxacillin.

Table 5 shows the distribution of gram- positive isolates according to susceptibility to antimicrobials agents. Most isolates of *S. aureus* were almost sensitive to most antibiotic. However, *S. aureus* isolate was resistant to ceftriaxone, clarithromycin, gentamycin and ceftazidime. *S. epidermidis* also were resistance ceftriaxone, clarithromycin, gentamycin and ceftazidime. According to the results were shown from tables 5,6. gram-negative bacteria had more resistance to the antibiotics.

Figure 1: Oxacillin resistance (MRSA)

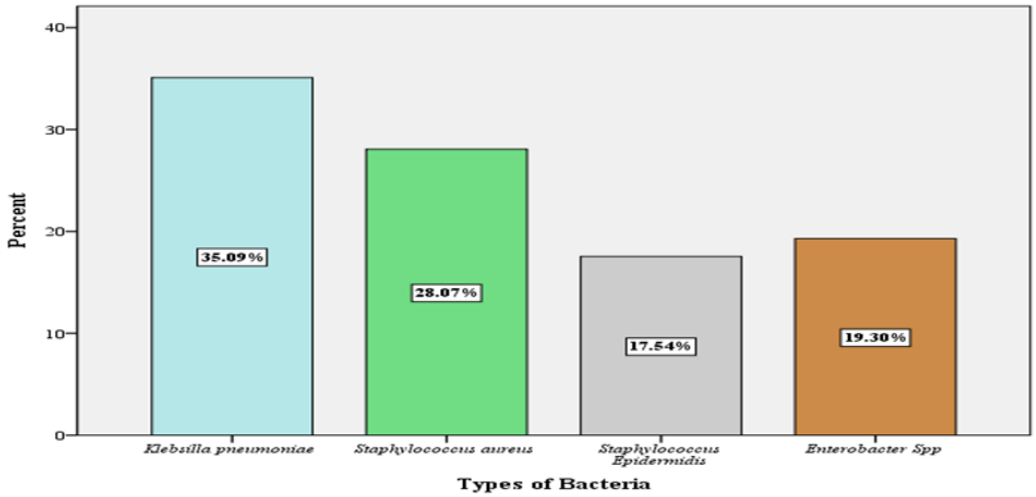

Figure 2: Distribution of the microorganisms identified in patients' blood culture after CVC insertion of (n=124)

Table 4. Distribution of Gram- Negative isolates according to susceptibility to antimicrobials agents

Antibiotic	Susceptible		Intermediate		Resistance	
	***K. Pneumoniae* (n=20)**	***Enterobacter Spp* (n=11)**	***K. Pneumoniae* (n=20)**	***Enterobacter Spp* (n=11)**	***K. Pneumoniae* (n=20)**	***Enterobacter Spp* (n=11)**
Imipenem	-	-	5	-	15	R
Ceftazidime	-	-	-	-	R	R
Ciprofloxacin	-	4	-	-	R	7
Vancomycin	2	1	-	1	18	9
Augmentin	-	-	-	4	R	7
Gentamycin	-	-	-	-	R	R
Doxycycline	18	-	2	-	-	R
Oxacillin	-	1	-	1	R	10
Levofloxacin	13	-	3	-	4	R
Amikacin	1	2	2	-	17	9
Meropenem	-	-	-	-	R	R
Ertapenem	-	-	-	-	R	R
Vancomycin	-	-	-	-	R	R
Clarithromycin	-	-	-	-	R	R
Ceftriaxone	-	-	-	-	R	R
Cefotaxime	-	-	-	-	R	R
Septime	-	-	-	-	R	R
Piperacillin/Tazobactam	-	-	-	-	R	R
Colistin	19	-	1	-	-	R

Table 5. Distribution of Gram- Positive isolates according to susceptibility to antimicrobials agents

Antibiotic	Susceptible N (%)		Intermediate N (%)		Resistance N (%)	
	***S. aureus* (n=16)**	***S. epidermidis* (n=10)**	***S aureus* (n=16)**	***S epidermidis* (n=10)**	***S aureus* (n=16)**	***S. epidermidis* (n=10)**
Imipenem	3	6	2	4	11	-
Ceftazidime	-	-	-	-	R	R
Ciprofloxacin	16	7	-	3	-	-
Vancomycin	12	2	-	7	4	1
Augmentin	7	5	-	3	9	2
Gentamycin	-	-	-	-	R	R
Doxycycline	16	10	-	-	-	-
Oxacillin	1		1		14	10
Levofloxacin	9	8	7	1	-	1
Amikacin	8	3	5	7	3	-
Meropenem	5	-	11	-	-	R
Linezolid	2	-	9	-	5	R
Clarithromycin	-	5	-	4	R	1
Ceftriaxone	-	-	-	-	R	R

4. Discussion

Although, CLA-BSI incidence and infection rates in the current study findings were higher than rates in many evidence in developed studies(13)(14)(15), lower CLA-BSI rates were reported comparing to other several studies(13)(16-20) and 11.3% of the patients died. The higher rate of CLA-BSI in this study than in developed countries could be explained by the fact that ICU patients in developing countries are at an increased risk for infection

4.1 CLA-BSI related Risk Factors:

The current study shows the risk factors for CLA-BSI among the ICU for 124 patients during the period from September 2021 to February 2022. These risk factors were displayed a higher possibility of CLA-BSI for renal failure, DM, and hypertension patients. But, a study was conducted in Egypt in 2018, was showed a high-risk factor for heart failure patients with p-value 0.01(16).

This study also finds that relationships between ICU length of stay and the occurrence of CLA-BSI in patients who longer stay in the intensive ICU, increase chance of CLA-BSI infection. It was also found that the most inserted medical devices that increase the incidence of CLA-BSI are the central venous line, while a study conducted in Egypt in 2018 found that mechanical ventilation was the most common device that causes CLA-BSI, with a rate of (5.4%) and p-value (0.02)(16).

It was also found in the current research that the most common CVC insertion site which increases the incidence of CLA-BSI is the subclavian, while in a study conducted in Jordan in 2019, the incidence of CLA-BSI was high in the femoral CVC site with rate (51.9%) and p-value (0.01)(20).

Another study conducted in (Cairo, Egypt), similar to this result, where the most common CVC insertion site that increases the incidence of CLA-BSI is the subclavian CVC site with a rate (11.3%) and Value (0.02)(21).

In the multivariate logistic regression analysis, an ICU stay of 5 days or more, renal failure, DM, hypertension, and CVC were the only independent risk factors for the occurrence of CLA-BSI in ICU patients. Other studies agreed a statistically significant association between the occurrence of CLA-BSI in ICU patients with ICU stay of 5 days scores or more(16)(19)(20).

4.2 Infection Rate and Bacteriological Profile:

The current study showed 45.6% of the infection was represented in gram positive bacteria, and 54.4% infected with gram negative

bacteria. An evidence in Libya was mentioned that of all positive cases of the bacterial isolates for BSI occurrence of gram-positive bacteria reached (52.9%), and the percentage of gram-negative was reported as (40.6%)(12). The highest distribution of the microorganisms identified in patients' blood culture was gram negative bacteria (*Klebsiella pneumoniae*), While a study conducted (in Brazil) in 2019 had the highest results for gram-positive bacteria (*Staphylococcus aureus*) the rate 15.4% and was lower results for (*Klebsiella pneumoniae*) the rate 12.8%, while a study in India (2016) had similar outcomes to the current study, where the highest results were for (*Klebsiella pneumoniae*) the rate 40%. The study in Brazil in 2019 showed many species of bacteria that cause CLA-BSI, such as *Pseudomonas aeruginosa , Staphylococcus aureus, Klebsiella, pneumoniae, Enterobacter spp., Acinetobacter spp*., Fungi, *Candida albicans, Staphylococcus epidermidis, Candida albicans, Enterococcus faecalis, Staphylococcus coagulase negatives, Klebsiella* (18). While the study in India in 2016 showed species such as *Klebsiella pneumoniae, Pseudomonas aeruginosa, Acinetobacter species, Stenotrophomonas maltophilia, Proteus species, Pantoea agglomerans, Sphingobacterium maltivorum, Porphyromonas species, Staphylococcus aureus, Enterococcus faecium, Enterococcus faecalis* (14). Only four species showed in the present study *Klebsiella pneumoniae, staphylococcus aureus, Enterobacter spp, staphylococcus Epidermidis*. The reason for the appearance of a small number of bacteria that cause CLA-BSI in present study because of the limited collected samples through 6 months in one healthcare facility. In addition, infection control surveillance and hospital accreditation are not mandatory at the national level and compliance with the rules of infection control programs is poor. In contrast, gram-positive skin organisms are frequently the most reported causative microorganisms of bloodstream infections (16)(17).

In the current study, gram-negative bacteria had more resistance to the antibiotics. Most isolates of *K. pneumoniae* were 100% resistant to most of antibiotic (Urgent threat). However, the result of antibiotic sensitivity testing showed that *K. pneumoniae* isolate was sensitive to colistin, doxycycline and levofloxacin respectively. *Enterobacter Spp* also were resistance to the most of antibiotic except ciprofloxacin, amikacin, vancomycin, and oxacillin.

The study findings are in agreement with study was held on hospitalized blood stream infection in adult patient in aljumhuriya hospital-Benghazi, Libya in year 2009-2010, the isolate gram-negative antimicrobials showed high degree of resistance to ampicillin (92%), piperacillin (82%). Unlike other results in same study whereas showed high degree of susceptibility to imipenem (92%), meropenem (90%), and Intermediate to augmentin (11.5%). Most isolates of *S. aureus* were almost sensitive to most of antibiotic. However, the result of antibiotic sensitivity testing showed that *S. aureus* isolate was resistant to ceftriaxone, clarithromycin, gentamycin and ceftazidime. *S. epidermidis* also were resistance ceftriaxone, clarithromycin, gentamycin and ceftazidime. This study findings are in agreement with study was held on hospitalized blood stream infection in adult patient in aljumhuriya hospital-Benghazi Libya in year 2009-2010 the isolate gram-positive antimicrobials showed high degree of susceptible to ciprofloxacin (90%) while the result is not the same in intermediate(11).

5. Conclusion

The current study revealed that Gram-negative organisms are the most common organisms associated with the incidence of CLA-BSI in ICU patients. K. pneumoniae was the most common causative agent for CLA-BSI episodes in medical ICU patients. It may be cautious to turn our attention to infections caused by these other pathogen groups that may require different approaches to prevention, for instance, optimizing central line maintenance practices. (8) In contrast, Gram-positive skin organisms are often the most commonly reported causative microorganisms of bloodstream infections, in particular aurus. The infection rate is considerably higher than that in recent studies

from developed countries. Preventive measures based on CDC guidelines should be reserved for patients with an expected longer stay in the ICU, and educational programs on antiseptic techniques and catheter installation and maintenance are essential to reducing infection rates. More research is needed.

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Conflict of interest

The authors declare that there is no conflict of interest.

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