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Electronic smart device surveillance: the effect of clinical nursing practice of central line-associated bloodstream infections on patients' outcomes

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Abstract:
Background: Surveillance is the backbone to determine local issues, priorities, and to assess the effectiveness of infection control policies. **Aim:** The study aimed to evaluate the effect of clinical nursing practice of central line-associated bloodstream infections on patients' outcomes by using electronic smart device surveillance. **Design:** This study used a quasi-experimental research design. **Setting:** The study was conducted in Trauma and Chest Intensive Care Units at Assiut University Hospital. **Sample size:** The sample used in the study included 112 critically ill patients who were divided into two equal groups, each with 56 patients, control group and study group, which was monitored by electronic smart devices. **Tools:** three tools were used to gather study data. **Tool I:** Patient assessment sheet, **Tool II:** Electronic smart device surveillance, and **Tool III:** Patient outcomes. **Results:** the most prevalent pathogen for the central line-associated bloodstream infections was 42.9% Klebsiella in control group, but 31.3% Enterobacter in study group, also there is a significant statistical difference in the control and study groups for the primary infection type and the outcome of admission with p-value $p<0.017^*$ and 0.000^*, respectively. **Conclusion**: Based on findings of the current study, it can be concluded that 57.1, 23.2, and 19.6% of patients respectively, had died, been discharge or been transferred as outcome for infection types in intensive care units. **Recommendation**: raise the awareness of ICUs staff on the value of surveillance program and how it can help lower HAIs.

Keywords: Bloodstream, Outcomes & Surveillance.

Introduction

Nosocomial infections, another name for healthcare-associated infections (HAIs), are a serious global health of the public issue, that have a substantial impact on morbidity, mortality, and healthcare costs. Nosocomial infections continue to remain a major burden in intensive care settings. **(Toma et al., 2025)**

Surveillance is the backbone to determine local issues, and priorities, as well as to assess the efficacy of infection control policies. Surveillance is a combination of process and outcome indicators. Outcomes are typically infections; however, processes are actions related to the prevention of infections, through the use of antibiotics or vaccination. (**Department of Health Resources, 2023) & (Rai et al., 2022)**

A central line-associated bloodstream infection (CLABSI) is a primary bloodstream infection (BSI) that does not have a bloodstream connection to an infection at another location and occurs after 48 hours following the BSI in a patient who had a central line. **(Alshahrani et al., 2023)**

Central line-associated bloodstream infections (CLABSIs) are another important category of HAIs. These infections occur when viruses or bacteria get into the bloodstream via a central venous catheter. Severe complications can include sepsis, prolonged hospital stays, and a higher death rate. **(Hill et al., 2024)**

Several professional associations have made focused and precise suggestions to lower HAIs. Using personal safety equipment appropriately and practicing good hand hygiene are essential. It is best to use central lines for little time as feasible and to remove as soon as they are no longer needed. **(Stephen, et al., 2022)**

Central line-associated bloodstream infections (CLABSIs) are laboratory-confirmed nosocomial infections that can be diagnosed if they happen at least 48 hours after the initial central line placement, the central line is still in place or was removed no more than a day prior to the date the blood culture's positive result, and there is no other source of infection. **(O'Grady et al., 2021)**

There is no evidence that prophylactic antibiotic administration prior to central line implantation lowers the incidence of CLABSIs. Flushing or locking tunneled catheters with an antibiotic and heparin appears to lower gram-positive catheter-related sepsis in patients who are susceptible to neutropenia. **(van den et al., 2021)**

The most common signs and symptoms of CLABSI are altered mental status, fever, chills, hypotension, lethargy, fatigue, inflammation, pain, swelling, discharge, redness, and difficulty drawing blood or poor flow. **(Mary Enlow, 2023)**

Implementing CLABSI surveillance criteria through the standard centers for Disease Control and Prevention/National Healthcare Safety Network (CDC/NHSN) can be difficult to understand and time-consuming and also possesses low-positive predictive value for detecting CLABSI. Modified criteria for CLABSI are defined as growth in blood culture from a central venous line samples with clinical signs and symptoms and with no other apparent causes of infection. This can be simple, cost-effective, and implementable in setups with little resources, and therefore must be examined. **(Rai et al., 2022)**

Significance of the Study:

The frequency rate of healthcare-associated infections (HCAIs) in Lower- and Middle-Income Counties (LMICs) has been reported to range from 5.7 to 19.1%. However, data on HCAIs is patchy, especially from LMICs, because of more insufficient infrastructure (such as data record keeping) and insufficient resources. 51% of patients admitted to intensive care units (ICUs) experienced HCAIs, which prolonged their hospital stay and increased their risk of contracting further infections and other morbidities, according to a multicenter study by the WHO that estimated HCAIs in ICUs. **(Haque et al., 2020)**

The incidence of ICU-acquired infections per 1000 patient days in Assiut University hospitals in the main hospital, January 2023 - December 2023, based on the Supreme Council of Universities in the chest ICU, was 3.62% including BSIs (1.81%), but the rate of device-associated infections per 1000 device days in the trauma ICU was 10.71% including BSIs (6.15%). **(Supreme Council of University Hospitals, 2024)**

Aim of the study:

The aim of the study is to evaluate the effect of clinical nursing practice of central line-associated bloodstream infections on patients' outcomes by using electronic smart device surveillance.

Subjects and Methods:

Study Design:

Quasi-experimental research design was conducted over a fourteen-month period.

Setting:

The study was conducted across the intensive care units of chest and trauma at Assiut University Hospital, Egypt, over a fourteen-month period (March 2023 and ending at the end of May 2024). The trauma intensive care unit of the hospital contains 17 beds. The patient-to-nurse ratio of the unit is 1:1. The number of patients admitted to the trauma ICU every year is 160 (Assiut University Hospital records). But the chest intensive care unit of the hospital contains 20 beds. The patient-to-nurse ratio of the unit is 2:1 and 3:1. The number of patients admitted to the chest ICU every year are 150. **(Assiut university hospital records)**

Patients

In the present study, 112 recently admitted critically ill patients in the Intensive Care Units of Assuit University Hospitals were included in the sample. For patients who suspect infection in the intensive care unit, the researcher gathered a sample of patients who were registered in smart device surveillance. The sample was recruited equally into two groups: a control and a study group (56 patients for each group and 28 patients from every ICUs). The control group were received routine hospital care. The study group who receives clinical nursing practice of central line-associated bloodstream infections, these patients who registered in smart device surveillance.

Inclusion criteria:

- **Sex:** Both men and women.
- **Age:** From the age of 18:65.
- Recent admission to ICU.
- Patients who suspect infection in the chest and trauma ICU who included in the surveillance.

Data collection Tools:

Three tools were utilized to collect data for this study:

Tool (I): Patient assessment sheet: After reviewing relevant literature, the researcher created this tool to evaluate patient's status in ICU. This tool includes three parts:

Part one: patient's personal data such as patient's code, age, sex, and marital status, and history of chronic disease

Part two: APACHE II (Acute Physiology and Chronic health evaluation II) Score form Physiologic variables, this part was adopted from (**Radhakrishnan et al., 2021).**

Part three: Hemodynamics status assessment which include for example: vital signs, and complete blood count. It collected by researcher after review the relevant literatures and adopted from **(Dean, 2020).**

Tool (II): Electronic smart device surveillance: It was adopted from **(Supreme council of universities, and Supreme infection prevention control (IPC) Committee, 2022)** which includes three sub items:

Clinical admission details as the name of the admitted ICU, diagnosis upon admitting to ICU, the date of insertion of a central venous line, a urinary catheter, and mechanical ventilator.

Infection type from electronic smart device surveillance

Signs and symptoms for the type of suspected infection related to blood stream infection (BSI)

include the patient complain of fever >38Oc with no other known cause, hypotension, chills, and oliguria <20mL/hr. **Investigation results from device for BSI** include a blood culture withdrawn from the patient, and name of it.

Tool (III): Patients' outcomes tool: researcher created this tool after reviewing relevant literature, to evaluate patient's outcomes in ICU. This tool includes outcome of the patient from the smart device surveillance is primary infection type, infection location, and outcome of this admission.

Methods:

Preparatory phase: Approval from the ethical committee, Faculty of Nursing, Assuit University, was obtained.

Permission to conduct the study was obtained from the administrative authorities of the previously mentioned setting after an explanation of the aim of the study. literature.

The content validity of the tool was evaluated by a panel of seven experts from faculty members specializing in critical care and emergency nursing. The experts reviewed the tool for clarity, relevance, comprehensiveness, and appropriateness to the study objectives.

The reliability of Tool I; part one and part three and tool III were assessed using Cronbach's alpha. The instruments demonstrated acceptable reliability, with alpha coefficients of 0.851.

A pilot study: Before the implementation of the main study, a pilot study was conducted on 10% of the total sample to evaluate the objectivity, feasibility, and clarity of the data collection tool. This preliminary phase ensured that the tools were practical and appropriately aligned with the study's objectives. The patients who participated in the pilot study were excluded from the main study sample to prevent any potential bias. Based on the feedback and findings from the pilot, necessary modifications were made to refine the tool for optimal application.

Ethical considerations:

- Research proposal was approved from ethical committee in the faculty of nursing.
- There was no danger for study subject during application of the study
- Common ethical guidelines for clinical research were followed by the study.
- Following an explanation of the study's nature and goal, patients or guidance who took part in it provided written consent.
- The patient received assurances that the research's data would not be used again without permission.
- Anonymity and confidentiality were guaranteed.
- Patients were free to decline participation in the trial or to leave at any moment without providing a valid reason.

Implementation phase:

Implementation phase will involve the following:

1. The Smart device surveillance was implemented in ICU; data will be collected and analyzed for the effect of clinical nursing practice of central line-associated bloodstream infections on patients' outcomes for study group and control group.
2. During implementation stage the researcher will assess the patient from the first day of admission until 7 days for 1st, 3rd, and 7th days every week in ICU by smart device surveillance according to Supreme council of universities, and Supreme IPC Committee. The following two tools were employed to gather data for this study:

Tool I: Patient assessment sheet includes

- Patient's personal and clinical data that include: information about patient such as age, sex, marital status, and history of chronic disease.
- APACHE II (Acute Physiology and Chronic health evaluation II) Score form Physiologic variables, this part was adopted from (**Radhakrishnan et al., 2021).**
- Hemodynamics status assessment created by researcher after review the relevant literatures and adopted from **(Dean, 2020),** which include **vital signs** as respiratory rate, heart rate, temperature, blood pressure and central venous pressure (C.V.P), **and complete blood count** as WBC_S, RBC_S, HCT, HGB level, and platelet count**.** It was adopted from **(Dean, 2020).**

Tool (II): Electronic smart device surveillance: It was adopted from **(Supreme council of universities, and Supreme infection prevention control (IPC) Committee, 2022)** which includes three subitems:

1. **Clinical admission details** as the name of the admitted ICU, diagnosis upon admitting to ICU, the date of insertion of a central venous line, a urinary catheter, and mechanical ventilator.
2. **Infection type from electronic smart device surveillance**
3. **Signs and symptoms for the type of suspected infection related to blood stream infection (BSI)** include the patient complain of fever >38Oc with no other known cause, hypotension, chills, and oliguria <20mL/hr. **Investigation results from device for BSI** include a blood culture withdrawn from the patient, and name of it.

Evaluation phase:

Outcome of the patient from the Smart device surveillance include:

- Primary infection type as central line-associated bloodstream infection (CLABSI).
- Infection location as on hospital admission, ICU Acquired infection, and hospital acquired infection.
- Outcomes of these patients were evaluated as died, discharge, and transferred.

Statistical analysis:
The computer software application was used to enter the data. Date entry, data analysis and interpretation were done using, a statistical program for the social sciences (SPSS), and version 22. Mean (standard deviation) was employed to evaluate quantitative variables and frequency (percentage) was used to characterize qualitative variables. The Fisher exact test or the chi-square test for categorical variables. Independent samples test, and paired samples test tests were used to demonstrate the relationship between the variables. P-value was considered statistically significant at P < 0.05.

Results:

Table (1): Percentage distribution of personal data about the patients in intensive care units (N=112)

Personal data	Control (N= 56)		Study (N= 56)		P-value
	No.	%	No.	%	
Age: (years)					
≤25	11	19.6%	6	10.7%	0.103
26 – 35	18	32.1%	16	28.6%	
36 – 45	24	42.9%	23	41.1%	
> 45	3	5.4%	11	19.6%	
Sex:					0.242
Male	38	67.9%	32	57.1%	
Female	18	32.1%	24	42.9%	
Marital status:					0.200
Single	12	21.4%	9	16.1%	
Married	29	51.8%	38	67.9%	
Divorced	9	16.1%	3	5.4%	
Widowed	6	10.7%	6	10.7%	

P>0.05 Is not Significance *chi-square test*

Table (2): Percentage distribution of chronic disease (N. =112)

Chronic disease	Control (N= 56)		Study (N= 56)		P-value
	No.	%	No.	%	
Diabetes mellitus	18	32.1%	18	32.1%	1.000
Hypertension	19	33.9%	18	32.1%	0.841
Chronic obstructive pulmonary disease (COPD)	3	5.4%	2	3.6%	1.000
Liver disease	1	1.8%	0	0.0%	1.000
Ischemic disorder	9	16.1%	4	7.1%	0.140
None	29	51.8%	27	48.2%	0.705

P>0.05 Is not Significance *Chi-square test* *fisher exact test*

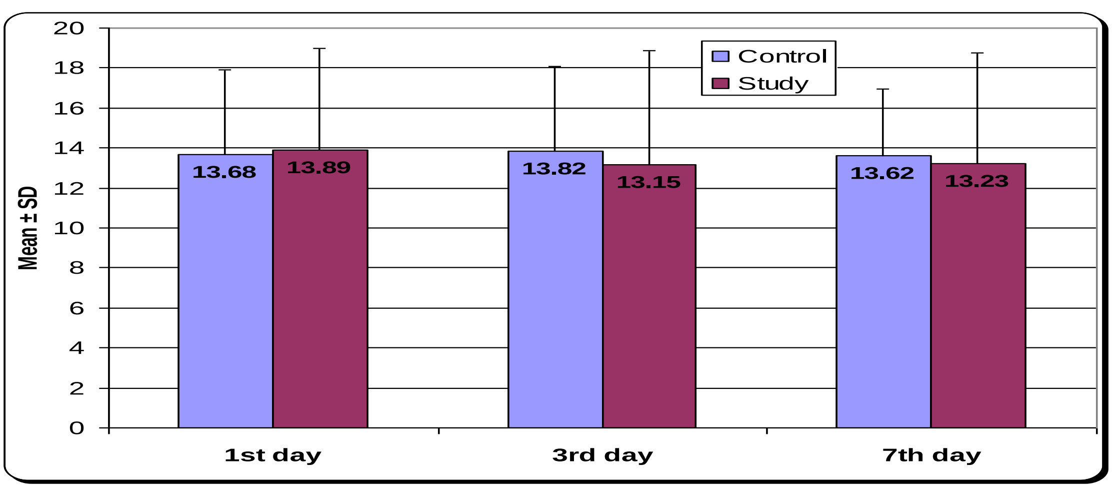

Figure (1): Percentage distribution of APACHE II: (Acute Physiology and Chronic health evaluation II) for the patients in intensive care units (N=112)

Table (3): Percentage distribution of clinical data from electronic smart device surveillance about the patients in intensive care units (N. =112)

Clinical data	Control (N= 56)		Study (N= 56)		P-value
	No.	%	No.	%	
Sitting:					1.000
Chest ICU	28	50.0%	28	50.0%	
Trauma ICU	28	50.0%	28	50.0%	
Diagnosis:					
Chronic obstructive pulmonary disease (COPD)	7	12.5%	9	16.1%	0.589
Pneumonia	19	33.9%	22	39.3%	0.556
Respiratory Failure (RF)	15	26.8%	16	28.6%	0.833
Disturbed conscious level (DCL)	17	30.4%	14	25.0%	0.526
Accident	16	28.6%	13	23.2%	0.518
(Sub Arachnoid hemorrhage or hematoma) SAH	5	8.9%	4	7.1%	1.000

P>0.05 Is not Significance ***Chi-square test*** ***fisher exact test***

Table (4): Percentage distribution of invasive devices and operation among studied patients in intensive care units (N. =112)

Insertion of devices and done of operation in ICU	Control (N= 56)		Study (N= 56)		P-value
	No.	%	No.	%	
Surgical operation					
Yes	9	16.1%	7	12.5%	0.589
No	47	83.9%	49	87.5%	
A central venous line inserted					
Yes	47	83.9%	48	85.7%	0.792
No	9	16.1%	8	14.3%	
A urinary catheter inserted					
Yes	52	92.9%	55	98.2%	0.364
No	4	7.1%	1	1.8%	
Mechanical ventilator					
Yes	33	58.9%	36	64.3%	0.560
No	23	41.1%	20	35.7%	
weaned from the mechanical ventilation					
Yes	0	0.0%	1	1.8%	1.000
No	56	100.0%	55	98.2%	

P>0.05 Is not Significance *Chi-square test* *fisher exact test*

Table (5): Percentage distribution of blood stream infection (BSI) as recorded from device surveillance among studied patients in intensive care units (N. =112)

infection type	Control (N= 56)		Study (N= 56)		P-value
	No.	%	No.	%	
Blood stream infection (BSI)	28	50.0%	16	28.6%	0.020*

P>0.05 Is not Significance *P<0.05 Is Significant* *Chi-square test* *fisher exact test*

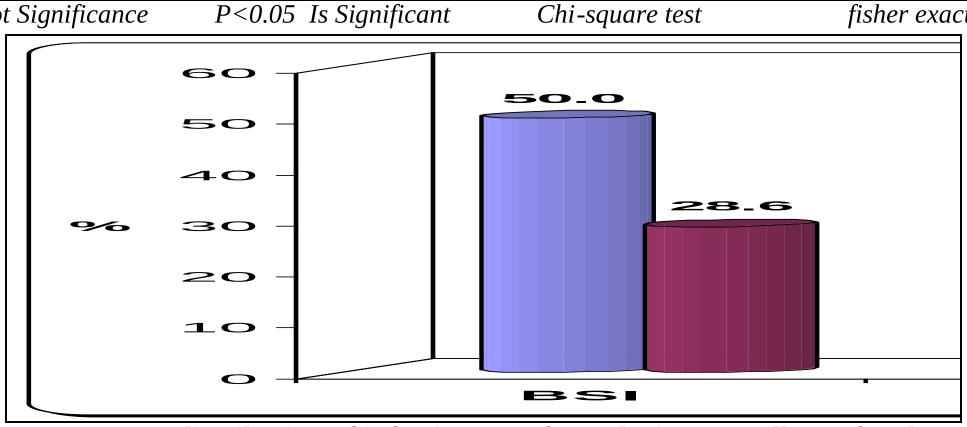

Figure (2): Percentage distribution of infection type from device surveillance for the patients in intensive care units

Table (6): Percentage distribution of signs and symptoms for the type of suspected infection related to blood stream infection (BSI) for the patients in intensive care units (N=44)

Items	Control (N=28)		Study (N=16)		P-value
	No.	%	No.	%	
Fever > 38c					
1st day	14	50.0%	12	75.0%	0.105
3rd day	22	78.6%	13	81.3%	1.000
7th day	18	64.3%	10	62.5%	0.906
Hypotension					
1st day	8	28.6%	9	56.3%	0.070
3rd day	14	50.0%	8	50.0%	1.000
7th day	11	39.3%	5	31.3%	0.594
Chills					
1st day	12	42.9%	10	62.5%	0.210
3rd day	16	57.1%	10	62.5%	0.728
7th day	12	42.9%	7	43.8%	0.954
Oliguria <20mL/hr.					
1st day	4	14.3%	5	31.3%	0.250
3rd day	3	10.7%	3	18.8%	0.652
7th day	2	7.1%	2	12.5%	0.614

P>0.05 Is not Significance *Chi-square test* *fisher exact test*

Table (7): Percentage distribution of investigation results about blood Stream Infection "BSI" for the name of pathogen for the patients in intensive care units (N =44)

Name of pathogen	Control (N= 28)		Study (N= 16)		P-value
	No.	%	No.	%	
Klebsiella	12	42.9%	4	25.0%	0.236
Acinetobacter	8	28.6%	3	18.8%	0.719
Enterobacter	4	14.3%	5	31.3%	0.250
Providencia	2	7.1%	0	0.0%	0.526
Pseudomonas	1	3.6%	2	12.5%	0.543
Aeromonas encheleia	1	3.6%	0	0.0%	1.000
Yeast	1	3.6%	1	6.3%	1.000
Staphylococcus	0	0.0%	1	6.3%	0.364
Sphingomonas	0	0.0%	1	6.3%	0.364
Acholeplasma	1	3.6%	0	0.0%	1.000
Streptococcus	1	3.6%	0	0.0%	1.000
Achromobacter	0	0.0%	1	6.3%	0.364

P>0.05 *Is not Significance* *fisher exact test*

Table (8): Percentage distribution of infection type for the patients in intensive care units (N=112)

	Control (N= 56)		Study (N= 56)		P-value
	No.	%	No.	%	
Primary infection type:					
LCBSI	25	44.6%	13	23.2%	0.017*
Device associated infections:					
CLABSI	12	21.4%	5	8.9%	0.242
Infection location:					
On hospital admission	28	50.0%	31	55.4%	
ICU Acquired infection	22	39.3%	17	30.4%	0.749
Hospital acquired infection	5	8.9%	6	10.7%	
Outcome of this admission:					
Died	15	26.8%	49	87.5%	
Discharge	23	41.1%	3	5.4%	0.000*
Transformed	18	32.1%	4	7.1%	

P>0.05 Is Not Significance *P<0.05 Is Significant* *P<0.001 Is Highly Significant*
Chi-square test *fisher exact test*

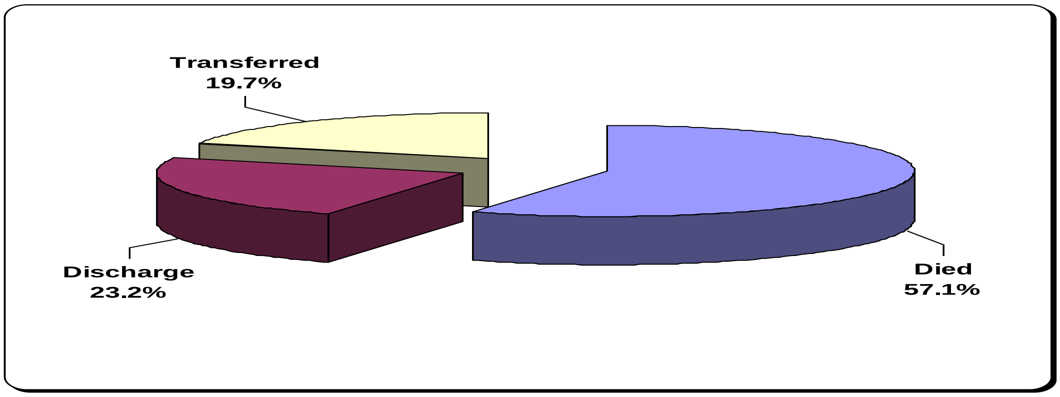

Figure (3): Percentage distribution of outcome for infection type of the patients in intensive care units (N=112)

Table (9): Frequency distribution of vital signs for the patients in intensive care units (N=112)

Vital signs	Control (N= 56) Mean + SD	Study (N= 56) Mean + SD	P-value[1]
Respiratory rate (RR):			
1st day	21.54 ± 6.84	22.27 ± 5.64	0.538
3rd day	22.04 ± 6.08	23.83 ± 5.36	0.106
P-value[2]	0.459	0.021*	
7th day	20.38 ± 5.08	23.30 ± 5.42	0.008*
P-value[2]	0.266	0.307	
Heart rate (HR):			
1st day	85.95 ± 16.85	93.36 ± 18.06	0.027*
3rd day	87.63 ± 13.67	98.11 ± 15.26	0.000*
P-value[2]	0.290	0.118	
7th day	86.85 ± 10.99	94.77 ± 18.27	0.012*
P-value[2]	0.368	0.778	
Temperature:			
1st day	37.46 ± 0.54	37.64 ± 0.93	0.202
3rd day	37.67 ± 0.67	37.94 ± 0.74	0.043*
P-value[2]	0.018*	0.041*	
7th day	37.69 ± 0.76	38.09 ± 0.94	0.026*
P-value[2]	0.035*	0.055	
Systolic BP:			
1st day	119.43 ± 18.31	116.79 ± 18.30	0.447
3rd day	116.96 ± 14.13	117.55 ± 13.85	0.828
P-value[2]	0.293	0.746	
7th day	116.87 ± 11.51	114.68 ± 19.21	0.500
P-value[2]	0.166	0.116	
Diastolic BP:			
1st day	73.57 ± 11.67	70.36 ± 13.75	0.185
3rd day	72.50 ± 10.14	73.96 ± 11.98	0.492
P-value[2]	0.484	0.139	
7th day	76.04 ± 10.05	71.70 ± 13.40	0.077
P-value[2]	0.528	0.562	
Central venous pressure (C.V.P.):			
1st day	8.27 ± 4.26	9.21 ± 5.00	0.283
3rd day	8.05 ± 3.68	9.53 ± 4.71	0.070
P-value[2]	0.586	0.331	
7th day	8.65 ± 3.95	10.09 ± 3.77	0.074
P-value[2]	0.193	0.050*	

P>0.05 Is Not Significance P<0.05 Is Significant P<0.001 Is Highly Significant
1: Comparison between Control and Study 2: Comparison with 1st day in each group
Independent samples T-test paired samples test

Table (10): Frequency distribution of complete blood count (CBC) for the patients in intensive care units (N=112)

complete blood count (CBC)	Control (N= 56)	Study (N= 56)	P-value[1]
	Mean + SD	Mean + SD	
White blood cells (WBCs):			
1st day	11.65 ± 5.79	16.06 ± 7.57	0.001*
3rd day	11.78 ± 6.39	15.44 ± 6.91	0.005*
P-value[2]	0.845	0.563	
7th day	11.76 ± 5.99	14.04 ± 6.64	0.082
P-value[2]	0.981	0.037*	
Red blood count (RBCs):			
1st day	17.90 ± 10.50	15.99 ± 11.46	0.361
3rd day	19.00 ± 11.34	16.74 ± 12.25	0.320
P-value[2]	0.000*	0.004*	
7th day	20.24 ± 11.61	16.81 ± 12.97	0.177
P-value[2]	0.000*	0.012*	
Hematocrit (HCT):			
1st day	33.24 ± 8.02	33.02 ± 8.65	0.888
3rd day	34.18 ± 7.70	34.12 ± 9.11	0.972
P-value[2]	0.099	0.247	
7th day	34.03 ± 9.55	32.02 ± 9.47	0.305
P-value[2]	0.353	0.246	
Hemoglobin (HGB):			
1st day	10.86 ± 2.63	10.70 ± 3.03	0.770
3rd day	10.54 ± 2.64	11.05 ± 2.56	0.302
P-value[2]	0.114	0.536	
7th day	10.94 ± 2.88	10.46 ± 2.90	0.420
P-value[2]	0.656	0.435	
Platelets:			
1st day	242.36 ± 126.12	233.34 ± 112.05	0.690
3rd day	245.39 ± 120.71	230.94 ± 97.02	0.494
P-value[2]	0.755	0.617	
7th day	250.69 ± 123.63	232.21 ± 117.58	0.458
P-value[2]	0.654	0.732	

P>0.05 Is Not Significance *0.05 Is Significant* *P<0.001 Is Highly Significant*
Independent samples T-test *paired samples test*
1: Comparison between Control and Study *2: Comparison with 1st day in each group*

Table (1): Illustrates the patients in intensive care units according to personal data, it was found that 42.9% were 36–45 years old, 67.9% of them were male, and 51.8% were married in the control group, and it was found that 41.1% were 36–45 years old, 57.1% of them were male, and 67.9% were married in the study group.

Table (2): According to this table, there was no significant statistical difference in the control and study groups as regards all items of chronic disease.

Figure (1): Demonstrates that the frequency distribution for the control and study group of APACHE II (Acute Physiology and Chronic Health Evaluation II) is (13.68 and13.89, respectively) for the patients in intensive care units.

Table (3): This table presented that there was no significant statistical difference in the control and study groups as regards all items of clinical data about the patients in intensive care units.

Table (4): This table demonstrates that there is no significant statistical difference in the control and study groups as regards all items of insertion of devices and done of operation for the patients in intensive care units.

Table (5): This table shows that there is significant statistical difference in infection type from device surveillance for blood stream infection (BSI).

Figure (2): Demonstrates that the percentage distribution for the control and study group of infection type from device surveillance for bloodstream infection (BSI) is (50.0% and 28.6% respectively).

Table (6): This table demonstrates that there is no significant statistical difference in the control and study groups as regards all items of signs and symptoms for the type of suspected infection related to bloodstream infection (BSI) for the patients in intensive care units.

Table (7): This table demonstrates that there is no significant statistical difference in the control and study groups as regards all items for investigation results from smart device surveillance about Blood Stream Infection "BSI". Also noted that; 42.9% of Klebsiella was the most prevalent organism responsible for CLABSI in the control group, but 31.3% of Enterobacter was the most common organism causing CLABSI in the study group.

Table (8): This table demonstrates that there is a significant statistical difference in the control and study groups from device surveillance for the patients in intensive care units, as regards items for the primary infection type of LCBSI and the outcome of admission with p-value ($p<0.017^*$ and 0.000^*, respectively).

Figure (3): Demonstrates that 57.1, 23.2, and 19.6% of patients respectively, had died, been discharge or been transferred as outcome for infection types in intensive care units.

Table (9): This table demonstrates that there is a significant statistical difference in vital signs for the patients in intensive care units in respiratory rate (RR) on 7th day with a p-value of ($p<0.008^*$). While heart rate (HR) is a significant statistical difference on all days with p-value of ($p<0.027^*$,0.000^*, and 0.012^*, respectively). Also, temperature is a significant statistical difference on the 3rd and 7th the days with p-values of ($p<0.043^*$and 0.026^*, respectively).

Table (10): This table demonstrates that there is a significant statistical difference in complete blood count (CBC) for the patients in intensive care units for White blood cells (WBCs) in the 1st and 3rd day with p-value of ($p<0.001^*$ and 0.005^*, respectively). Also, there is significant statistical difference in RBCs in 3th and 7th in comparison with 1st day in each group with P-value ($p <0.000^*$ and $p <0.004^*$, respectively) and ($p<0.000^*$and $p<0.012^*$, respectively).

Discussion:

Healthcare-associated infections (HAIs) are related to the use of invasive devices such as a central line, which can result in central line-associated bloodstream infection (CLABSI), Foley catheters, which can cause catheter-associated urinary tract infection (CAUTI), and ventilators which can result in ventilator-associated pneumonia (VAP) and ventilator-associated events (VAE). However, additional HAIs are iatrogenic but non-device associated, including bloodstream infections (BSI), urinary tract infections (UTI), and pneumonia; or procedure-related, including surgical site infections (SSI), and other HAIs are connected to the dialysis procedures. **(National competitiveness center, 2024)**

The present study was applied in trauma and chest intensive care units. This study aimed to evaluate electronic smart device surveillance: the effect of clinical nursing practice of central line-associated bloodstream infections on patients' outcomes, through assessment of the patient personal and clinical data, APACHE II (Acute Physiology and Chronic Health Evaluation II) Score, smart device surveillance, hemodynamics status assessment, and patient outcomes.

Regarding personal and clinical data were reported that less than half of patients from (36 – 45) years, more than half were male, but less than half were female and three-quarters were married. The study supported by **Iordanou et al., (2017),** monitoring of mortality and infections linked to devices in a large intensive care unit in the Republic of Cyprus. Data were reported that more than half were male but less than half were female patients who were admitted to the ICU.

Regarding chronic disease for patients, the present research reported the study and control groups did not significant statistical difference as regards all items of chronic disease. This was similar to **Mahmoud, (2020),** who carried out their study to assess infection control standards precautions on patient outcomes with mechanical ventilation, however, with relation to every chronic illness category, the study and control groups did not statistically significant difference in any way.

Concerning APACHE II (Acute Physiology and Chronic Health Evaluation II) for the patients in intensive care units, there is a significant statistical difference in comparison with the 1st day and the 7th day with a p-value of ($p<0.044^*$). The study supported by **Iordanou et al, (2017),** who evaluated in a large intensive care unit in the Republic of Cyprus, surveillance of device-associated infections and mortality revealed that patients' median APACHE II scores were 22 vs. 25 and 49 vs. 48, respectively. The two scoring methods and the device-associated healthcare-associated illnesses (DA-HAIs) did not significant difference. In agreement **with previous findings Wassef, et al, (2020),** who carried out their study to assess Care Bundle Approach to reduce surgical Site Infections in Cairo, Egypt's Acute Surgical Intensive Care Unit, there was significant statistical difference with P-value ($p<0.04^*$).

Regarding the infection type from device surveillance for the number of patients for the present study, it illustrates that BSI (44). According to earlier research **Dramowski,** (**2017),** who applied a study on the alternative surveillance techniques, performed variably for detecting HAI as laboratory-confirmed bloodstream infection (LC-BSI) (n=41). The most common HAIs were less than quarter for BSI, which is in line with earlier conclusions **Izadi et al., (2020),** who used data from the national nosocomial infections surveillance to determine Iran's hospital-acquired infection incidence rate.

According to research findings regarding bloodstream infection (BSI) for the names of pathogens for the patients in intensive care units, the ongoing research shows that a higher percentage of pathogens for the patients' bloodstream infection (BSI) that less than half were Klebsiella, also quarter of them were Acinetobacter, but less than quarter of them were Enterobacter, and Pseudomonas. This is consistent both **Sellamuthu et al., (2023) & Singhal et al., (2019),** risk factors for bloodstream infections linked to central lines (CLABSI): As per a prospective study conducted by a pediatric intensive care unit in South India, that less than quarter were Klebsiella pneumonia, Acinetobacter baumannii, and coagulase-negative staphylococci were found to be the incidence, etiology, and antibiotic vulnerability of patients in intensive care units to bloodstream infections linked to central lines. Overall, it was identified that the most prevalent organism causing CLABSI was Klebsiella pneumonia. A similar view was reported by **Apostolopoulou et al., (2013),** who executed out their study to evaluate Monitoring of Device-Related Mortality and Infection Rates in Greek intensive care units, whereas less than half were Acinetobacter baumannii and Klebsiella pneumoniae that more prevalent in CLABSI (n = 66).

Regarding the outcome for the infection type of the patients in intensive care units, the control and study groups differed statistically significantly from device surveillance as regards items for the primary infection type of LCBSI and the outcome of admission with p-value (p<0.031* and 0.000*, respectively). The study supported by **Duszynska et al., (2020)**, who carried out their study to evaluate the monitoring, prevention, and cost assessment of device-associated health care-associated infections at the University Hospital's intensive care unit in Poland revealed a marked increase in the death rate among infected patients (23.6%) with a p-value (p<0.01*).

In terms of vital signs of the patients in intensive care units, our study analysis, there was a significant statistical difference in vital signs for the patients in intensive care units in respiratory rate (RR) on the 7th day with a P-value (p<0.008*). In contrast, Heart Rate (HR) exhibits a statistically significant variation across all days, with p-values of (p<0.027*,0.000*, and 0.012*, respectively). Furthermore, there is a significant difference in the temperature between the third and seventh days, as indicated by p-values of (p<0.043* and 0.026*, respectively). This was stated with **Abd EL Baky, (2014),** who carried out their study on the effect of three standardized oral hygiene practices on bacterial colonization in patients on mechanical ventilation, that the vital signs such as temperature, pulse, and respiration were highly significant with p-values (p<0.001, 0.003, and 0.001*, respectively). In disagreement with previous findings **Austin et al., (2022),** who conducted their study to assess a surveillance technique based on evidence to detect and report bloodstream infections via catheters or cannulas in patients undergoing parenteral feeding, there was no significant difference in abnormal vital signs.

Regarding complete blood count (CBC) for the patients in intensive care units, there was a significant statistical difference between the control and study groups for complete blood count (CBC) for the patients in intensive care units in white blood cells (WBCs) for the 1st and 3rd days with p-values (p<0.001*and p<0.005*, respectively). Also, there is a significant statistical difference in white blood cells (WBCs) on the 7th day and red blood count (RBCs) on the 3rd day compared to the 1st day in each group with a p-value (p< 0.037*, 0.000*, and 0.004*, respectively), but there was no significant statistical difference among all CBC items. However, **Radhakrishnan et al. (2021),** who conducted their study to assess in their tertiary care center study, they found that the impact of training and checklist-based application of ventilator-associated pneumonia (VAP) preventive bundle strategy on patient outcome was no significant statistical difference in hemoglobin, hematocrit, or platelets with p-values of (p< 0.781, 0.898, and 0.324, respectively).

Limitations:

These limitations found in some months during the study

- Limited resources for personal protective equipment and for hand hygiene.
- Limited number of nurses for the number of patients in the chest ICU.
- Limited access to laboratory tests for culture.
- Increase the rate of patients in the ICU.
- The workload and many efforts for nurses in the ICU

Conclusion:

Based on the results of the present study, it can be concluded that:

- This study provides that the infection types reported from device surveillance are bloodstream infection (BSI) with percentage of 49.1.
- The highest outcome for infection type of the patients in intensive care units died for bloodstream infection (BSI).
- The most common pathogen for CLABSI was (42.9%) Klebsiella in control group, but (31.3%) Enterobacter in study group.

Recommendation:

- Apply clinical nursing practice of central line-associated bloodstream infections by using electronic smart device surveillance
- Perform all appropriate preventative nursing practice to fulfill these roles; nurses must be well educated on the preventative strategies and be able to putting that knowledge into performance.
- Raise the awareness of ICUs staff on the value of surveillance program and how it can help lower HAIs.
- Track infection control program, look for defects and attempt to resolve it.

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