Assiut Scientific Nursing Journal
http://asnj.journals.ekb.eg
http://www.arabimpactfactor.com

Relation Between Incidence and Risk Factors of Septicemia Among Burned Patients (A Suggested Nursing Educational Brochure)

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Abstract
Background: The major challenge for a burn care team is nosocomial infection. Infection of the burn injury leading to septicemia is the main cause of death. **Aims:** Assess the relation between incidence and risk factors of septicemia among burned patients and design a suggested nursing educational brochure. **Methods:** A descriptive correlational research design was utilized, data were collected using; **Tool (I**) Structured interview questionnaire, consisted of patients' demographic and medical data, which included: general, local assessment, laboratory investigations, blood culture and patient prognosis. **Tool (II**) risk factors of septicemia. In addition to a suggested nursing educational brochure. Data collected for a full year (*November 2017– October 2018*) on (101) convenient burned patients admitted in the burn unit at Assiut University hospital. **Results:** The prevalence of septicemia, around one third of the studied burned patients had a positive blood culture (staphylococcus). The mean TBSA were 34.73±24.27, all patients had invasive devices, major of them had an abnormal CBC results and discharged but near one quarter dead. **Conclusion**: There were a statistically significant relation between cause of burn, TBSA, wound changes and dressing type with patient's positive blood culture results (septicemia). **Recommendations**: Application of the developing strategies for infection control, early detection and treatment of infection (septicemia) among the burned patients.

Keywords: ***Burn, Incidence, Nursing Educational Brochure, Risk Factors & Septicemia.***

Introduction
Infection of the burn injury leading to septicemia is the main cause of death, after the initial period of shock. Burn is an injury to tissues caused by contact with dry heat (fire), moist heat (steam or liquid), chemicals, electricity, lightning, or radiation. Safety measures in the home and on the job are extremely important in the prevention of burns (**Omar et al., 2017)**

The American Burn Association (ABA) has defined criteria for sepsis and wound infections. The ABA published burn-specific sepsis criteria with a total of 6 variables to consider. Meeting 3 of these criteria should prompt the clinician to consider the presence of a clinically significant infection and to initiate empirical antimicrobial therapy. A patient meets the definition of sepsis if these criteria are coupled with a documented infection (defined as a positive culture result, confirmatory histopathology finding, or a clinical response to antimicrobials) **(David, 2017).**

Wound infection in a burn patient should be differentiated from wound colonization. Thus, local signs for an inflammatory response such as pain, edema and redness, combined with the presence of pus in the wound area and systemic signs such as fever or increased leucocyte number should raise the suspicion of infection. Conversely, in colonization, although the bacterial cultures from wounds are positive, no clinical signs of infection are present and there is no evidence for microscopic infection **(Rowan et al., 2015)**

The burn injury causes devitalization of total body surface area (TBSA) and produces extensive raw areas, which become moist due to the exudation of plasma, forming a medium ideal for the colonization and proliferation of various types of micro-organisms. The affected individual's immune system is depressed and dysfunctional, and this, compounded by the large cutaneous bacterial load, the possibility of gastrointestinal translocation, prolonged hospitalization and associated invasive diagnostic and therapeutic procedures, all contribute to sepsis **(Rhodes et al., 2017**)

The Surviving Sepsis Campaign provides general treatment guidelines and recommendations, most of which are applicable to burn patients. After the presumptive diagnosis of sepsis has been established, biological samples should be collected for microbiological studies and fluid resuscitation should be started immediately, along with timely (within 1 hour) initiation of antimicrobial therapy followed by source control when feasible. Although controversy

exists as to whether any survival benefit is derived from the "one hour rule," (**Sterling et al., 2015),**

Prevention of sepsis is one of the main goals for anybody involved in the care of the patient with severe burns. There are several techniques, in addition to standard infection control measures, which are thought to reduce the risk of infection and sepsis; some of which are well established while others remain more controversial. Several of these techniques will be discussed along with a summary of the current evidence underlying them **(Rhodes et al., 2017**)

Significant of the study

Infection in the burned patients is the leading cause of morbidity and mortality and it is one of the greatest challenging concerns for the burn care team. So prevention and management of infection is a primary concern in the treatment of patients with severe injuries and require immediate specialized care to reduce morbidity and mortality caused by infection and septicemia. Nurses have important role to prevent infection and burned patients require knowledgeable and skillful nurse for prevention or early detection of septicemia. Infections remain a leading cause of death in burn patients. For patients with burn size greater than 40% TBSA, 75% of all deaths are due to infection **(Ascanio, 2018)**. So, the importance of this study is to assess the relation between incidence and risk factors of septicemia among burned patients

Aims of the study

- Assess the relation between incidence and risk factors of septicemia among burned patients.
- Design a suggested nursing educational brochure.

Specific objectives

- Estimate incidence of septicemia in burned patients.
- Identify risk factors among burned patients.
- Assess the relation between incidence and risk factors of septicemia among burned patients.
- Design a suggested nursing educational brochure.

Research question

Is there a relation between incidence and risk factors of septicemia among burned patients**?**

Research design: A descriptive correlational research design was utilized to fulfill the aim of this research.

Technical Design

Sitting: This study was conducted in Burn unit at Assiut University hospital.

Subjects:

The data for a full year **(November 2017– October 2018)**

A convenience sample of (101) burned patients admitted in burn unit at Assiut University hospital.

Exclusive criteria of the studied patients:

- Obese patients.
- Hypertension
- Diabetic patients

Tools of data collection

Two tools were utilized in this study

Tool (I): Structured interview questionnaire

This sheet was developed by the researchers after reviewing of national and international literatures to assess the patients' demographic and medical data.

It included two parts

Part (1): Demographic characteristics includes gender, residence, age, marital status, cause and site of burn.

Part (2): medical data, it included:

a. General assessment: Level of consciousness, fluid resuscitation, and presence of invasive devices.
b. Local assessment: wound changes (color, odor, drainage,…..) and TBSA through body graph to calculate the total percentage.
c. Laboratory Investigations: CBC (WBCs)
d. Blood culture (positive or negative)
e. Patients' prognosis (discharged or dead)

Tool (II): Risk factors assessment sheet

This tool aimed to assess the presence of risks among the studied patients.

It was in a check list form contained presence or absence of the following risk factors which in relation to incidence of septicemia among burned patients:

Fluid resuscitation, dressing type, presence of invasive devices, and TBSA.

Scoring system

Score 1= present/ abnormal

Score 0 =not present/ normal

***The suggested nursing educational brochure:**

It was developed by the researchers based on the literature review.

Designed in simple Arabic language based on opinion of nursing and medical expertise, and researcher experience to evaluate the effect on the incidence and risk factors of septicemia on burned patients.

It contains the colored and simple knowledge and practice steps for nurses working with burned patients.

It aimed to improve nurse's performance (knowledge and practice) for prevention, early detection and care of septicemia in burned patients it consisted of two parts:

Part one: knowledge about septicemia including definition, signs and symptoms causes, risk factors and complications.

Part two: nursing practice for prevention, early detection and care for patients with septicemia. In

addition to infection control procedures (hand washing, donning & doffing PPT, and septic technique).

Tools validity and reliability

The tools were tested for for clarity, relevance, comprehensiveness, understanding, applicability and easiness, minor modifications were required by 5 experts of academic medicine and nursing staff from the faculty of medicine and nursing at Assiut University.

Modifications were done accordingly, and then the tools were designed in its final format. The Content reliability was estimated by Alpha Cronbach's test and its result were R=0.68 and 0.81 content validity.

pilot study

A pilot study was conducted on 10% of the study patients (10 patients). The purpose of the pilot study was to detect any particular problem in the statements clarity, feasibility, and applicability of the tools. No change was done in the data collection tools, so the patients selected for the pilot study were included in the main study.

Methods of data collection

Preparatory phase: A review of current and past, local and international related literature in the various aspects of the problem using books, articles, periodicals, and magazines was done.

Administrative design

An official approval letter was secured from Nursing Faculty Dean at Assiut University to the director of setting. Before starting any data collection, the explanation for the study aim was done to obtain permission and cooperation for data collection.

Implementation phase: Data were collected in burn unit at Assiut University Hospital during the period from **(November 2017– October 2018).**

- The tools were all filled with interviewing patients to explain the purpose of the study through 30 minutes for each patient individually.
- Oral consent obtained from every patient individually.
- The researchers follow the studied patients for 5 days/ week during the morning and afternoon shifts for 3 hours per shift. The interview was done in the patients' rooms and the assessment during the dressing time in the dressing room after following the sterile technique and using the universal precautions.
- Each month nearly from 8 to 9 patients admitted in the burn unit and the researchers followed up using the study tools.
- Patient data was collected by the researchers using **(Tool I)** to assess:
  - The demographic characteristics of studied group includes gender, residence, age, marital status, cause and site of burn (part 1).
  - The medical data (part 2), included; general assessment: Level of consciousness, fluid resuscitation, and presence of invasive devices.
  - While local assessment: the researchers observed the wound changes (color, odor, drainage) and TBSA during the burn wound dressing in the morning shift. The researcher filled the graph of TBSA to calculate the total percentage.
  - Assessing general and local health as level of consciousness, temperature, pulse, respiration and urine amount, in addition to complete blood count and blood culture result taken from the routine laboratory investigations, form the laboratory reports in the patients' folders.
  - The researcher followed up the patients' prognoses form their hospital admission periods till their discharge or death.
  - This tool nearly 30 minutes for filling all parts of it.
  - The risk factors of septicemia among the studied patients were done by using (**Tool II**), through filling the check list of presence or absence of each risk factor by asking the patients and from the patients' folders.
  - This tool took 15 minutes to fill it.
  - While the researcher not available in the burn unit they contacted with the nursing staff to follow up the admitted patients' conditions and their prognosis and any new admitted patients.
  - A designed nursing educational brochure was developed based in simple Arabic language by the researcher based on national and international literature review, opinion of nursing and medical expertise, and researcher experience to improve nurse's knowledge and practice for early detection of septicemia in burned patients and consists of two parts:
  - **Part one**: knowledge about septicemia including definition, signs and symptoms causes, risk factors and complications with colored pictures.
  - **Part two:** nursing practice for early detection and caring for patients with septicemia.
  - Specific precautions as regards activities to minimize infection during the following procedures: cannula insertion, IV fluid infusion, blood transfusion, urinary catheter insertion, suctioning, nasogastric tube insertion (Ryle), burn wound care.

Hand Hygiene steps

Observations of health care worker’s hand hygiene practices were conducted using the WHO patient

safety observation form **(WHO, 2018),** during the "5 moments for hand hygiene", which are;
1) Before touching a patient, 2) Before clean/ aseptic procedures, 3) After body fluid exposure risk, 4) After touching a patient, and 5) After touching patient surroundings.
The main goal of this part is to recognize that hand washing is one of the most effective actions that can take to reduce incidence of septicemia among burned patients.

Donning and doffing steps
Steps of wearing and doffing PPE when caring for residents with suspected or confirmed septicemia (how to wear and take off gown, mask and gloves.

Preparing sterile field:
- Steps of preparing and maintaining the septic technique principles.
- The final designed nursing educational brochure printed in colored forms and given for each nurse and the head nurse of the burn unit, at Assiut university.

Verbal permission with an explanation of the nature and aim of the study was obtained from clinical resident and head nurse of the burn unit. Also, a verbal consent was obtained from each patient to be included in the study. Clarification of the nature and purpose of the study was done during the initial interview with each patient. The researcher emphasized that participation is voluntarily. Confidentiality of the patients was certainly assured.

Statistical design
Data collected and entered by Microsoft Excel 2016 program, the SPSS version (21) (Statistical package for social science) used for statistical analysis of data. The frequency used to calculate count and percentage of qualitative data e.g. gender, where descriptive used to calculate the mean ± standard deviation for quantitative data (e.g. Age). Chi-square test used to test the relation between qualitative variables where T-test used to test the relationship between quantitative. ^{ns} $P > 0.05$ no significance and * $P < 0.01$ moderate significance

Ethical consideration

Results
The results of this study were presented in three parts as follows:
Part I: Demographic characteristics and medical data of studied patients (Tables 1&2).
Part II: Risk factors of septicemia (Table 3)
Part III: Relationships (Tables 4,5&6)

Part I: Demographic characteristics and medical data of studied patients.

Table (1): Frequency and percentage distribution of demographic characteristics and medical data (N.=101).

Items	Group	
	N. =101	%
Gender:		
Male	58	57.4
Female	43	42.6
Residence:		
Urban	25	24.8
Rural	76	75.2
Age:		
18 < 25	35	34.7
25 < 40	30	29.7
40- 65	36	35.6
Mean ± SD	36.31	±14.89
Marital status:		
Single	43	42.6
Married	58	57.4
Cause of burn:		
Scald	43	42.6
Flam	52	51.5
Electrical	6	5.9
Chemical	0	0.0
Site of burn		
Extremities	76	75.2
Face, neck , abdomen	25	24.8

Table (2): Frequency and percentage distribution of the studied Patients' health assessment and laboratory investigations (N. = 101).

Items	Group	
	N. =101	%
1. General:		
• **Level of consciousness:**		
Oriented	70	69.3
Confused	18	17.8
Inappropriate words	11	10.9
Incomprehensible words	1	1.0
Comatose	1	1.0
• **Fever or hypothermia**		
Yes	49	48.5
No	52	51.5
• **Tachycardia or bradycardia:**		
Yes	45	44.6
No	56	55.4
• **Tachypnea**		
Yes	38	37.6
No	63	62.4
• **Oliguria**		
Yes	13	12.9
No	88	87.1
2. Local (wound changes):		
• **Chang in depth**		
Yes	25	24.8
No	76	75.2
• **Change from moist to dry**		
Yes	24	23.8
No	77	76.2
• **Development of eschar**		
Yes	46	45.5
No	55	54.5
3. Laboratory Investigations:		
• **CBC component**		
Normal	41	40.6
Abnormal	60	59.4
• **Blood culture result**		
Positive	37	36.6
Negative	64	63.4
Organism name	Staphylococcus	

Part II: Risk factors of septicemia

Table (3): Frequency and percentage distribution of the studied patients' health assessment and prognosis of the septicemia (N.=101).

Items	Group	
	N. =(101)	%
• **Fluid resuscitation**		
Done correctly	101	100.0
Incorrectly	0	0.0
• **Dressing type**		
Open	7	6.9
Closed	94	93.1
• **Presence of invasive devices**		
Yes	101	100.0
No	0	0.0
• **If yes what**		
central line	1	1.0
central line, Foley catheter	42	41.6
Foley catheter	2	2.0
Foley catheter, cannula	4	4.0
Cannula	52	51.5
ET/NT	0	0.0
NG tube	0	0.0
TBSA		
< 15	11	10.9
From 15% to 35%	51	50.5
From 36% to 55%	23	22.8
From 56% to 75%	8	7.9
> 75%	8	7.9
Mean ± SD	34.73±24.27	
Prognosis:		
Discharged	75	74.3
Death	26	25.7

Part III: Relationships

Table (4): Relation between demographic data of the studied patients (as considered a risk factor) and blood culture results (N. =101).

Demographic data	Blood culture result				P value
	Septicemia (Staphylococcus)		Normal		
	N. (101)	%	N. (101)	%	
Age					0.382^{ns}
18 < 25	10	9.9	25	24.7	
25 < 40	11	10.9	19	18.8	
40- 65	16	15.9	20	19.8	
Gender					0.377^{ns}
Male	20	19.8	38	37.6	
Female	17	16.8	26	25.8	
Marital status					0.013^{ns}
Single	10	9.9	33	32.7	
Married	27	16.8	31	40.6	
Residence					0.037^{ns}
Urban	20	19.8	5	4.9	
Rural	44	43.6	32	31.7	

Demographic data	Blood culture result				P value
	Septicemia (Staphylococcus)		Normal		
	N. (101)	%	N. (101)	%	
Cause of burn					0.0001*
Scald	2	1.9	41	40.6	
Flam	34	33.6	18	17.9	
Electrical	1	0.9	5	4.9	

*Chi-square test * significant at 0.05*

Table (5): Relation between other risk factors and blood culture results of the studied patients (N. =101).

Risk factors	Blood culture result				P. value
	Septicemia (Staphylococcus)		Normal		
	N. =101	%	N. =101	%	
Dressing Type					.009*
Open	6	5.9	1	0.9	
Closed	31	30.7	63	62.4	
Wound Changes					
Red	8	7.9	55	54.7	
Brown	14	13.9	4	3.9	0.001*
Black	13	12.9	1	0.9	
Greenish	2	1.9	4	3.9	
Aseptic Technique					
Yes	35	34.7	63	62.5	.302 ns
No	2	1.9	1	0.9	
Invasive Devices					
Yes	37	36.6	64	63.4	-
No	0	0.0	0	0.0	
TBSA					
< 15	0	0.0	11	10.9	
From 15% to 35%	3	2.9	48	47.7	
From 36% to 55%	19	18.9	4	3.9	0.0001*
From 56% to 75%	8	7.9	0	0.0	
> 75%	7	6.9	1	0.9	

Use Pearson chi-square (cross tabs test).
**=Significant difference Ns= Non significant difference P value<0.05*

Table (6): Relation between laboratory investigations and patients' prognosis septicemia among the studied burned patients (N. =101).

Lab. Investigations	Patients' prognosis N.=(101)				P value
	Discharged		Death		
	N.=101	%	N.=101	%	
CBC					
Normal	41	40.6	0	0.0	0.0001*
Abnormal	34	33.7	26	25.7	
Culture					
Staphylococcus	14	13.9	23	22.8	0.0001*
Normal	61	60.4	3	2.9	

*Chi-square test * significant < 0.05*

Table (1): Demonstrated that more than half of patients were males (57.4%), most of them were from rural area (75.2 %), less than half of them (35.6%) were in the age group 40- 65 with Mean ± SD (36.31±14.89), more than half of them (57.4%) were married. According to cause of burn around half of them (51.5%) was flam. The most affected site was the extremities (75.2 %).

Table (2): Showed according to general assessment of patients, most of the patients were oriented (69.3%), with no fever or hypothermia (51.5%), tachycardia or bradycardia (55.4%), tachypnea (62.4%), or oliguria. (< 30ml) (87.1%). According to local assessment of wound most of them with no changes in depth from superficial to deep (75.2%), from moist to dry (76.2%), or development of eschar (54.5%). According to laboratory Investigations more than half of the studied patients (59.4%) with abnormal CBC component, (36.6%) from them had a positive blood culture and the result was Staphylococcus the most bacterial infection found in this research.

Table (3): Illustrated according to risk factors all of patients (100%) with presence of invasive devices, (51.5 %) of them were cannula. The mean TBSA was ranged from 15% to 35% with mean± SD (34.73±24.27) and majority of them (74.3%) discharged but 25.7% dead.

Table (4): Showed that there was no statistical relation between blood culture result and patient's age, sex, marital status and residence (P. >0.05) but there was a significant relation with the cause of burn mainly flam burn was the main cause of burn and septicemia (P. < 0.001*)

Table (5): Mentioned that there is a statistically significant relation between TBSA, dressing type, wound changes and blood culture results (0.009 and 0.001 respectively). But there was no statistical relation between aseptic technique and blood culture results. However, no statistics are computed regarding invasive devices because it was a constant.

Table (6): Showed that there was a statistically significant relation between the laboratory investigation, culture result and patient prognosis septicemias among studied burned patients (P. 0.0001*).

Discussion

The aims of the present study were to assess the relation between incidence and risk factors of septicemia among burned patients in addition to, design a suggested nursing educational brochure.

Sepsis is a major cause of death worldwide and remains the subject of much research and debate within the critical care community. Despite advances in burn prevention, treatment, and rehabilitation, sepsis remains a common cause of death in patients who have sustained a severe burn injury **(Rowan et al., 2015).**

This research results demonstrated that; more than half of patients were males, this study finding was in the same line with **Lam et al., (2019**) who found in other study results that male patients were predominant more than three quarters.

This study result was compatible with **Lee et al., (2016)** who found that the major number of burned patients were males. In addition, that result was not in the same line with **Anlatıcı et al., (2017)** who found that there was a preponderance of female victims in their study. The vast majority of female adults were housewives, and most of the men were employed outside the home.

Regarding residence of the studied burned patients, most of them were from rural area that considered compatible with **Smolle et al., (2017)** who mentioned that burn injuries reported to be usually more common in the lower socio-economic strata and in the productive age group.

Less than half of the studied patients' ages were from 40 to 65 years old, more than half of them were married, this study result was not in the same line with **Dhopte et al., (2017)** who found that majority of these victims were of the age group 21-25 years. But agreed with the study of **Eidelson et al., (2018**) who found that married female victims far outnumbered unmarried females, their ratio being 5.9: 1 and the majority of burned patients were ranged 20-40 years old.

In addition, all the studied patients didn't receive hydrotherapy and the cause of burn, around half of them was flam. These study results were not in the same line with **Luis et al., (2016)** who mentioned in their study that the most common mechanism causing burn injury in both sexes is scald. Overall scalds account for nearly third of the total population admitted.

The mean TBSA in the current study being from 36% to 55% with mean ± SD **(**34.73 ±24.27**). Assadian et al., (2015**) also showed that majority of the participants' TBSA about 40.8 ± 12.5 that was compatible with this study result.

According to general Symptoms (septicemia symptoms) most of the patients were oriented**,** nearly half had no fever, hypothermia, tachycardia or bradycardia, tachypnea. Two third of them suffered from oliguria. According to local wound changes, also three quarters of them had not any change in depth or from moist to dry but nearly half developed an eschar**.** This study result was in the same line with **Rebarczyk et al., (2017).**

According to laboratory investigations more than half of the patients had an abnormal CBC

component. around one third had a positive blood culture and less than two third of them and the result was Staphylococcus, generally, the common organism found in this research because it is the most micro found in Assiut university hospital (**Statistical records of Assiut university hospital infection control center, 2017). Stylianou et al., (2015)** found in their study that Pseudomonas aeuroginosa was the most common organism isolated from burned patients. However, **Cabral et al., (2018)** reported that majority of the septicemic episodes in their study were due to gram positive cocci, while only quarter were due to gram negative bacilli.

According to risk factors; all of the studied patients with an invasive devices, nearly half of them had inserted cannula. In addition, this in the same line with some studies which had identified association of invasive procedures such as catheters with increased risk of infections and mortality. Blood stream infection in burn patients had also been found to be associated with mortality (**Mohapatra et al., 2014).**

Three quarters of the studied patients discharged but one quarter dead. **Stylianou e al., (2015)** founded that a total in-hospital mortality of burn injuries. **Freystätter et al., (2018)** mentioned in their study that septicemia was the most common cause of death, accounting for 213 which represented nearly three quarters of victims.

The results of the present study mentioned that: there was a statistically significant relation between cause of burn, TBSA, dressing type, wound changes and blood culture results (septicemia). But there were no statistically significant relation between aseptic technique, computed fluid resuscitation, and invasive devices because it was a constant with culture results. These study findings were in the same line with **Assadian et al., (2015)** who concluded that TBSA had a great relation with incidence of septicemia among burned victims.

Factors that significant on univariate firth analysis were older age, female gender, suicidal burns, higher TBSA, presence of inhalation injury, increased depth of burn, with positive microbial cultures. On multivariate analysis, higher TBSA was identified as an independent risk factor for mortality **(Dhopte et al.,2017).**

The present study found the mean TBSA was 34.73±24.27 that contributed with the higher mortality in this subset of patients. The current study previously reported that TBSA involved increases with higher ages. A study conducted by **Chelidze et al., (2016)** in Tanzania on predictors of burn mortality had reported female gender association with mortality that showed trend towards being significant.

Females take up the task of cooking in the kitchen at an early age making them more prone to fire-related injuries. Likewise, the widespread usage of kerosene stoves rather than liquefied petroleum gas (LPG) compromises the safety of the kitchen **(Tsurumi et al., 2015).**

Inhalation injury has been traditionally associated with higher mortality in burn injuries. There are studies implicating inhalation injury as an independent risk factor for mortality in children and when associated with other risk factors, it significantly increases the mortality from burn injuries **(Saeman et al., 2016).**

Few studies had reported higher incidence of mortality in patients sustaining thermal burns as compared to scald injuries. Higher mortality among thermal burn patients is the result of higher TBSA involvement, greater depth of burns, and associated inhalational injury **(Freystätter et al., 2018).**

Conclusion

Based on the finding results it concluded that:

Around one third of the studied patients had increased risks of septicemia mainly with staphylococcus. The studied patients' cause of burn, TBSA and dressing type appeared to be a significant risk factors of septicemia.

Recommendations

based on the study findings,

- Nurses who work with burned patients should be provided with sufficient information training and awareness about septicemia symptoms and early detection and continuous surveillance of burn infections.
- Developing strategies for infection control and treatment of infectious complications among the burned patients.
- Providing a pamphlet containing information about health education needed for the patients in the burn unit in a suitable vibrant place for preventing the incidence and risk factors of septicemia among such group of patients.

Declaration of conflicting interests

The authors declare that there is no conflict of interest

Funding

The authors declare that they have not received any direct or indirect funding from any organization for the research.

Acknowledgments

We would like to thank all the nurses in burn unit at Assiut University Hospital for their efforts to participate in this study.

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