

Performance Indicators; Association between the Quality of Preventive Nursing Care provided and incidence of Pin Site Infection.

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Abstract

Background: Performance indicators used today to determine to what extent nurses render care using quality of care standards. Pin site infection remains a problematic issue face health care providers, so this study **aims** to explore relation between quality of preventive nursing care provided and incidence of pin site infection. **Research hypothesis:** incidence of pin site infection among patients who received preventive nursing care would be lesser than those who had exposed to routine hospital care. **Research design:** A Quazi experimental design was utilized to conduct study. **Setting:** Study was conducted at Assiut University Hospital. **Sample:** Sixty patients admitted in trauma department at Assiut University Hospital. **Tools:** (I): Patient assessment sheet, (II) Infection Staging Tool based on criteria (**Checketts et al., 1993**). **Results:** Only two cases Grade I (6.7%) appeared in study group while ten cases (33.3%) grade I, II, III (6.7%, 20.0%, and 6.7 %) respectively appeared in control group. **Conclusion:** We found that few incidence of pin site infection is associated with quality of the preventive nursing care provided. **Recommendation:** pin site infection should be used as an indicator for quality of nursing care and as a comparison or benchmarking over time between hospitals. Conducting collaborative workshops between nursing and medical management for health care providers to stress the importance of preventive nursing care as general and for preventing pin site infections as special, and its impact on patients and organization as a whole.

Key words: Performance. Indicator. Quality. Nursing Care. Incidence. Pin Site. Infection.

Introduction

Health care professionals; mainly nurses based on their role are directly responsible for care rendered to perform their work adequately with careful measures the results will be satisfactory for both. Indicators are based on standards of care, today performance indicators used to determine to what extent nurses rendered care using global quality of care standards. Pin site infections are considered one of the most common complications associated with the use of skeletal pins and wires and it can be used as a performance indicator to measure quality of nursing care provided (**Griffiths et al., 2010**).

Performance indicators serve many purposes; It provides a quantitative basis for clinicians, organizations, and planners aiming to achieve improvement in care and the processes by which patient care is provided, enables professionals and organizations to monitor and evaluate what happens to patients as a consequence of how well professionals and organizational systems function for the needs of patients, and permits useful comparisons (**Jan Mainz, 2003**).

Indicators that measures performance includes many types; Rate-based or sentinel, related to structure/process/outcome, Generic or disease-specific, type of care (preventive, acute or chronic), function (screening, diagnosis, treatment, follow up), modality (history, physical examination, laboratory/radiology study, medication), and/or other interventions. Indicators for performance allow the quality of care and services to be measured (**McCance et al., 2012**).

Skeletal pins have been used to treat fractures since before the 1800s (**Patterson, 2005**), and the use of external fixation devices has been in practice since the 1920s (**Santy, 2000**). Skeletal pins or wires are inserted into the bone through skin incisions. It penetrates through the skin and soft tissue into the bone fragments. Some may penetrate through the bone and exit on the other side of the extremity, other pins may penetrate just into the periosteum of the bone (**Timms et al., 2011**). When the pins or wires are attached to an external frame an external fixator system is created. As the pins and wires disrupt the skin barrier; pin sites are susceptible to infection (**Kazmers et al., 2016**).

Pin site infection is broadly defined as signs & symptoms of infection around pins or wires that require the administration of an antibiotic, pin or wire removal, or even surgical debridement. Infection may range from superficial infection at the skin-pin/wire insertion interface to osteomyelitis and deep

tissue infection, which are serious complications. Deep infection can be difficult to treat; it may delay healing and significantly impact on patient outcomes. Pin site infections can be avoided with adequate preventive care. Management must assure that nurses evaluate the patients' clinical condition and risk factors; define and use interventions consistent with patients' needs, monitor and evaluate the effect of interventions ([Dimitri et al., 2016](#)).

Significance of the study

Our study adopted the concept (prevention is better than cure) based on this; various studies have been conducted with different approaches on prevention of pin site infection but no one of these studies handled the preventive nursing care as a package or holistic approach to prevent the development of pin site infection which can be used as indicators for quality of care provided.

Aim of the study:

To explore the relation between the quality of preventive nursing care provided and incidence of pin site infection.

Research hypothesis:

H: The incidence of pin site infection among patients who will receive the preventive nursing care for developing pin site infection will be lesser than those who exposed the routine hospital care.

Operational definitions:

Performance indicator: In this study it refers to the incidence of pin site infections that develop as a consequence of preventive nursing care provided.

Preventive nursing care provided: In this study it refers to a package of five process of preventive nursing care that was revised by experts and implemented by researchers: preoperative preparation, postoperative pin sites care, position of affected limb, exercises, and instructions before discharge.

Pin site Infection: In this study it refers to various degrees of inflammation of skin changes around the pin site and graded from I-VI as measured through infection staging tool based on criteria ([Checketts et al., 1993](#)).

Patients and Methods

Research design

A Quazi experimental research design was utilized in this study.

Setting:

The study was performed in trauma department at Assiut University Hospital.

Research variables:

Dependent variable: Incidence of pin site infection.

Independent variable: Quality of preventive nursing care provided.

Sample:

Overall sixty adult patients treated with external fixator due to lower extremities fracture (ankle and tibia) which applied as the first stage of treatment and all patients were waiting for the second stage of immobilization "open reduction and internal fixation" (ORIF); these patients were divided equally into 2 groups: study group comprising patients who received the preventive nursing care for pin site infection and patients who exposed to routine hospital care serving as the control group. Each of them was thirty patients. All patients were from a single trauma department; we matched the two groups for the following variables; age, sex, type and grades of fracture (closed grade II and III), Orthofix fixators that used, number of pins (more than four pins) and length of stay ranged from three to five days. The study excluded patients aged > 60 years and patients with pathological fractures due to tumors, polytrauma, Patients with chronic disease,

psychological or mental problems and who were smokers, obese, and corticosteroid administrators.

Tools for data collection

Tool (I): Patient assessment sheet

This sheet was developed by researchers based on national and international literature review to assess socio-demographics of studied patient and clinical data. It consisted of two sections:

First section: Socio-demographic data

It was developed to assess patients' socio demographic characteristics as name, age, sex, locality, educational level, and marital status.

Second section: Clinical data

It included structured items such as duration of immobilization, associated injuries and other variables.

Tool (II): Infection Staging Tool based on criteria by Checketts et al., (1993)

Is a validated clinical assessment tool to consistently define and categorize pin site infection. This scale was adopted in this study once (two weeks post-operative) to measure the grades of pin site infection.

Grades of infection	Characteristics
Grade-I	<ul style="list-style-type: none"> - Slight discharge - Redness around the pins
Grade-II	<ul style="list-style-type: none"> - Redness of the surrounding skin - Pain and tenderness in the soft tissue - Discharge of pus.
Grade-III	<ul style="list-style-type: none"> - Similar To Grade-II - Fail to improve with intensive local treatment and antibiotics.
Grade-IV	<ul style="list-style-type: none"> - Severe soft tissue involvement - Affecting more than one pin - Associated loosening of the pin
Grade-V	<ul style="list-style-type: none"> - Clinical appearance same as grade-iv - Bone involvement - Radiographs show osteomyelitis
Grade-VI	<ul style="list-style-type: none"> - Sequestrum formation within the bone - A persistent sinus develops

Grade I- III = Minor infections. Grade IV- VI = Major infections

Checketts and Otterburn's Grading System for infection

Scoring of this scale:

It has six grades from grade I to VI; from grade I to grade III consider minor infection while from grade IV to grade VI consider major infection.

Operational design:-

It included preparatory phase, content validity, pilot study, field work phase "implementation phase and evaluation phase.

Preparatory phase:

This phase started by extensive reviewing of current, past, local and international related literatures as text books, articles, journals, periodicals and magazines were done and study tools were formulated.

Content validity:

Content validity was done by five expertise (three nursing staff) from the medical-surgical nursing field and (two orthopedic surgeon) from the medical field to test relevance of the contents, clarity and comprehensiveness of the tools. Five expert teams assessed the five processes of nursing care with guideline-based review criteria. Reliability of the tools were assessed by using Test- Retest method ($r= 1$). The reliability test score shows there is a stability and consistency in the tools items. Hence the tools were considered highly reliable to the study.

Pilot study:

Pilot study was conducted on 10% of sample in selected setting (6 patients) to evaluate applicability and clarity of the tools, estimate the time needed for data collection, test the feasibility of conducting the research after analyzing the pilot study results, slight modifications were done accordingly. These patients were not included in the actual study.

Ethical consideration

In this study, we anonymized the patient characteristics that could lead to recognition of an individual. The study was approved by administrative board.

Methods

The study proceeded using the following steps:

- Written permission was obtained from the Institutional Review Board of Assiut University Hospital Management to conduct the research. Patients were informed about objective of the study and its applications and verbal consent of the patients was received.
- The researchers met the selected patients; each patient from both groups (study and control) was fully informed with the purpose and nature of the study and the patients' agreement was obtained. Base line data was completed using tool I.
- Data were collected between 8:00 and 12:00 AM on the first Tuesday of April 2016.
- Each study group patients received preventive nursing care for developing pin site infection by researchers and two nurses from the trauma department who were responsible for wound dressing in the department as the assignment of work was functional method.
- Preventive nursing care had been started preoperatively once the patient is planned for external fixator application. Skin preparation had done by shaving and disinfecting the skin by betadine solution.
- Intraoperative phase was excluded from the researchers' implementation.
- All patients returned to the ward with antiseptic-impregnated (povidone-iodine) gauze tampons placed around the external fixator pin site which removed 48 to 72 hours after the operation.
- First; the external fixator pin site was observed by researchers for bleeding, discharge, drainage, and infection. Pin site care was begun 48 to 72 hours after the operation.
- A continuous daily pin site care was done using a 10% povidone-iodine solution in the care of pin sites through sterile applicators using aseptic technique. Crusts were removed. After pin site care was carried out, the site was dried with a dry sterile applicator. The rationale for using povidone-iodine solution was the availability of this disinfecting solution in the hospital.
- Then the second preventive nursing care was regarding position "elevating the affected limb 30-45 degree to reduce edema".
- Next performing exercises to the muscles around the affected site as calf and quadriceps muscles.
- Finally they received before discharge teaching and instructions regarding continuing daily pin site care with normal saline and self-care activities which they must do it during the period of immobilization by external fixators until it removed.
- The researchers monitored patients' commitment to instructions that they received it before discharge every three days by telephone until they came back for follow up visit fifteen days postoperative. The period of immobilization by external fixators varied between patients. Also we followed the removal time of external fixator by telephone.
- Routine medical management for prevention of pin site infection was; all patients received prophylactic antibiotic by injection preoperatively. In addition; oral anti-inflammatory and antibiotic had been prescribed for them to take it at home for one week after discharge.
- All study & control group patients returned for follow up and reassessed fifteen days postoperative for detecting and recording grades of infected pin sites by using tool II (Infection Staging Tool).

Statistical analysis:

Data entry and analysis were done using SPSS (statistical Package for Social Science version 16). Data were presented by using the following tests; number, percentage, chi square, mean and standard deviation. Continuous data are expressed as a mean \pm SD. Comparisons between the two groups were made by the T-test. Correlation was determined by Pearson's correlation coefficient. Statistical significance was defined as $p < 0.05$.

Results:

Table (1): Shows that there were no statistical significant differences between study and control groups according to their socio-demographic data. Also this table reflects that the highest percentage of patients in both study and control groups was males and their age was less than thirty five years (86.7%, 66.7% & 46.7%, 60.0%) respectively.

Table (2): Illustrates a statistical significant decrease in number of study group patients who developed pin site infection (6.7 %) than control group (33.3%) as the incidence of pin site infection among control group was higher than study group. Furthermore this table clarifies distribution of grades of pin site infection among study and control groups as only grade I (6.7%) was apparent in study group while control group developed grade I,II,III (6.7%, 20.0%, 6.7%) respectively.

Table (3): Reflects a statistical significant relation between pin site infection and long period of immobilization as the ten cases of control group that developed pin site infection were having long period of immobilization (more than forty days). There was no statistical significant relations with the other two variables (associated injuries & age groups).

Table (1): Comparison of patients' socio-demographics among studied patients.

Variables	Study (n= 30)		Control (n= 30)		P. value
	No.	%	No.	%	
Age groups					
18- 35 years	14	46.7	18	60.0	0.585 ^{n.s}
35-50 years	8	26.7	6	20.0	
More than 50 years	8	26.7	6	20.0	
Mean+SD	37.30±15.24		35.13±12.39		0.548 ^{n.s}
Gender					
Men	26	86.7	20	66.7	0.067 ^{n.s}
Women	4	13.3	10	33.3	
Education level					
Non educated	12	40.0	11	36.7	0.663 ^{n.s}
Write and Read	3	10.0	1	3.3	
Secondary education	12	40.0	13	43.3	
University	3	10.0	5	16.7	
Occupation					
Office work	1	3.3	2	6.7	0.193 ^{n.s}
Farmer	10	33.3	8	26.7	
Professional	0	0.0	6	20.0	
Student	2	6.7	4	13.3	
Machinery work	5	16.7	3	10.0	
Housewife	3	10.0	3	10.0	
non-working	3	10.0	2	6.7	
Other job	6	20.0	2	6.7	
Locality					
Rural	16	53.3	18	60.0	0.602 ^{n.s}
Urban	14	46.7	12	40.0	
Marital Status					
Single	11	36.7	8	26.7	0.455 ^{n.s}
Married	19	63.3	21	70.0	
Widow or widower	0	0.0	1	3.3	

Chi-square test - Independent T- test- n. s. = non-significant

Table (2): Between-groups comparison of grades of pin site infection as measured by infection staging tool.

Grades of Pin site infection	Study (n=30)		Control (n=30)		P. value
	No	%	No	%	
Pin site status					
Non infected	28	93.3	20	66.7	0.011*
Infected	2	6.7	10	33.3	
Grades of infected pin site					
Grade I	2	6.7	2	6.7	-
Grade II	0	0.0	6	20.0	-
Grade III	0	0.0	2	6.7	-
Grade IV	0	0.0	0	0.0	-
Grade V	0	0.0	0	0.0	-
Grade VI	0	0.0	0	0.0	-

Chi-square test *Statistically Significant difference at P. value < 0.05

Table (3): Relation between Pin site infection and the following variables (associated injuries, duration of immobilization, and age).

Variables	Pin site infection									
	Study (n= 30)					Control (n= 30)				
	Non infected (N= 28)		Infected (N= 2)		P. value	Non infected (N= 20)		Infected (N= 10)		P. value
	No	%	No	%		No	%	No	%	
Associated injuries										
No	19	67.9	1	50.0	0.605 n.s	8	40.0	1	10.0	0.091 n.s
Yes	9	32.1	1	50.0		12	60.0	9	90.0	
Duration of immobilization (External fixator removal)										
10 < 30 days	11	39.3	2	100.0	0.591 n.s	3	15.0	0	0.0	0.021*
30 < 40 days	7	25.0	0	0.0		8	40.0	1	10.0	
40 < 50 days	5	17.9	0	0.0		9	45.0	5	50.0	
50 < 60 days	2	7.1	0	0.0		0	0.0	2	20.0	
60 to above	3	10.7	0	0.0		0	0.0	2	20.0	
Age groups										
18- 35 years	14	50.0	0	0.0	0.053 n.s	13	65.0	5	50.0	0.607 n.s
35-50 years	8	28.6	0	0.0		4	20.0	2	20.0	
More than 50 years	6	21.4	2	100.0		3	15.0	3	30.0	

Chi-square test * Statistically Significant relation at P. value < 0.05 n. s. = non-significant

Discussion

The quality of health care is on the agenda in most health care systems. Therefore; it is inevitable to measure the outcomes and contribution of nursing interventions and initiatives on patient care through the use of performance indicators.

The most important study results are in line with our hypothesis that supposed the group of patients who will receive the preventive nursing care will have less incidence of pin site infection than those who exposed to the routine hospital care. From the researchers' point of view; this few number of pin site infection among study group patients has been occurred due to the preventive nursing care provided to those patients.

Many study findings (Santy, 2000; Temple & Santy, 2004; and Holmes and Brown, 2005) have been reported that pin sites infection rates were high (86.5%). Sharma et al., (2005) added pin site infection was 85% in the Western countries. In our study results there was a statistical significant difference between incidence of pin site infection among study and control group as only two patients of study group are

experienced only grad I of pin site infection as compared with ten patients of control group who experienced grade I, II, & III of pin site infection. This indicating the quality of nursing care provided that was reflected through the performance indicator. Another study conducted by **(Ann-Margreet et al., 2016)** was in the same line with our study findings which discussed the association between preventive nursing care and incidence of pressure ulcer which found that there was a significant association between the development of pressure ulcer and the quality of the preventive care process provided.

This study handled the preventive nursing care as a package that consisted of five integrated process namely; preoperative preparation, pin site care using aseptic technique, correct position, exercises, and commitment to instructions received before discharge. In contrast to other studies which implemented each item separately as **(Bernardo, 2001)** who described pin site care involves inspecting the site for signs of infection (tenting, redness, tenderness, purulent discharge) and cleansing the pin sites. Cleansing is further divided into frequency, technique for applying cleansing agent(s), removal of crusts, and use of dressings. Each point where the skeletal pins puncture the skin and soft tissue needs to be managed as an individual wound.

On the other hand; **(Bibbo and Brueggeman, 2010)** studied position only as they reported that post-operative limb elevation is an important preventive measure. They advocate limb elevation whenever the patient is not actively mobilizing. As this reduces edema around the pins and creates optimal environment for rapid healing of the pin tracks.

Also **(American College of Sports Medicine, 2010)** emphasized on the importance of initiating light isometrics exercises (strengthening and muscle endurance) for 2 to 3 weeks following immobilization, because neither the bone nor cartilage can tolerate excessive compressive or bending forces. These exercises can keep structures in the related area in a state as near normal as possible without jeopardizing alignment of the fracture site while it is healing.

In addition to the mentioned above **(National Association of Orthopedic Nurses, 2005)** NAON recommended that patients and their families should be provided with education about pin site care before discharge and that this should be supported by the provision of written, oral and visual format instructions. This positive difference in study incidence may be due to the implementation of preventive nursing care as a package.

Our study results also illustrates that there are a statistical significant relation between pin site infection and long period of fixation. This means that the development of infection at the pin site affected negatively on the normal fracture healing process so it is delayed and led to long period of fixation. **(Temple and Santy 2004; W-Dahl et al., 2003)** support our study finding as they reported; the presence of infection at the pin site delays patient mobilization. On the other hand, it causes severe complications including osteomyelitis, delayed fracture healing, non-union, loss of fracture alignment and systemic infection. These complications not only have implications for the patient, but also incur financial costs as a result of costly treatment of infection and prolonged periods of hospitalization.

Furthermore, no statistically significant relation in our study results has been founded between pin site infections neither associated injuries nor age groups. This means that incidence of infection totally not related to age groups of patients or associated other injuries; this guide us to understand the important role of preventive nursing care.

The results of the present study are consistent with a study conducted by **(Manimozhi, 2015)** entitled as “Effectiveness of hydrogen peroxide dressing versus betadine dressing on pin site infection among patients with external skeletal fixators, in Orthopedic ward at Government Rajaji Hospital” which revealed that there was no statistical significant association in posttest level of infection with patients’ demographic variables.

Conclusion

We found that the incidence of pin site infection was associated with the quality of the preventive nursing care process, indicating that variation in the incidence between two groups reflects variation in the quality of nursing care provided.

Recommendation

- Occurrence of pin site infection should be used as an indicator of the quality of nursing care and as a comparison or benchmarking over time between hospitals.
- Conducting collaborative workshops between nursing management and medical management for health care providers to stress the importance of preventive nursing care as general and for preventing pin site tract infections as special, and its impact on patients and organization as a whole.

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