Effect of Implementing Evidence Based Nursing Practice Guideline on Clinical Outcomes of Patients with Acute Cervical Cord Injury

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Abstract: *Cervical cord injury is a traumatic event that results in many complications which include respiratory compromise, hemodynamic instability, and disturbance to normal sensory and motor function that impacts a patient`s physical, psychological and social wellbeing. The nursing guidelines for the management of acute cervical cord injury were developed and implemented.* ***Aim:*** *Evaluate the effect of implementing evidence based nursing practice guideline on clinical outcomes of patients with acute cervical cord injuries.* ***Design:*** *Quasi-experimental design was utilized in this study.* ***Setting:*** *Anesthesia Intensive Care Unit, affiliated to Tanta University Hospital.* ***Subjects:*** *A convenience sample of 40 patients who had acute cervical cord injury was selected and divided equally into two equal groups; study group was received evidence based nursing guidelines, control group was received only routine intensive care.* ***Tools:*** *Three tools were used for data collection* ***Tool I****: Patients Cervical Cord Injury Assessment,* ***Tool II****: Muscle Strength and Sensory Assessment for Cervical Cord Injured Patients,* ***Too III****: Clinical Outcomes Assessment Scale for Cervical Cord Injured Patients.* ***Results:*** *There were highly statistically significant differences between both study and control groups throughout the study period regarding clinical outcomes. Physiological parameters were improved in the study group, (100%) have normal vital signs, and no one had chest, urinary infection or deep vein thrombosis.* ***Conclusion:*** *Implementing evidence based nursing practice guideline has a positive effect on mean score of their clinical outcomes.* ***Recommendation:*** *Evidence based nursing practice guideline should be implemented and followed when caring for patients with acute cervical cord injury.*
Key words: *Evidence based nursing practice guideline, Clinical outcomes and cervical cord injury*

I. Introduction:

Cervical cord injuries (CCI) represent a potentially devastating injury to the patient. Early diagnosis of CCI is important to provide early management and prevent secondary injury. The cervical spine is the most widely recognized area in the spine that to be injured, representing over 60% of cases. It comprises of seven vertebrae and is divided into upper and lower cervical spine. It is definitely not a notifiable illness so incidence may vary based on the source [1]. In 2019, World Health Organization estimated a global incidence for spinal cord injury from 65 to 90 new cases for around million people per year [2]. In Egypt, 12, 000 deaths have been reported yearly, in addition to many thousands of non fatal CCI that accompanied with long term disability [3]. According to review of Tanta Main University Hospital Statistical Records; it was revealed that 65% patients with CCI were admitted to Tanta Emergency Hospital in 2019 [4].

Cervical cord injury is destruction to the cervical spine that results in temporary or permanent deterioration in its function. It is more popular in men. People aged 18-35 are more common to sustain CCI. Patients with bone and joint diseases are also more liable to cervical cord injuries. Approximately half of CCI results from motor vehicle accidents and falls. Gunshot wounds responsible about 11 % of cases and sports cause about 9 % of cervical cord injuries. Diseases such as arthritis, osteoporosis, and cancer are other causes [5].

The effect of CCI on the function of the body occurs as following; cervical vertebrae 1 to 4 are accompanied with full paralysis of the limbs, cervical vertebra 5 are associated with paralysis of the wrists, hands, and triceps, cervical vertebrae 6 paralysis of the wrist flexors, triceps, cervical vertebrae 7- 8 had hand muscle weakness, difficulty grasping and injury from cervical vertebrae 5 to 8 have difficulty coughing.

Additional signs and symptoms of CCI are bradycardia, hypotension, irregular body temperature, and breathing dysfunction. The complications include spinal, neurogenic shock, autonomic dysreflexia, quadriplegia, ineffective respirations, cardiovascular complications, increased risk of thrombosis, spasticity, infection and alterations in bowel and urinary elimination[6].

Management of cervical cord injured patient's needs cooperation of health care disciplines to enable patient to achieve fullest potential function after injury. The goals of ongoing management are to stabilize or realign the spine to prevent further neurological deterioration, prevent complications, and initiate prompt interventions. Management includes; nursing assessment, emergency care, medical and surgical management. Emergency care; when the injury is at the cervical vertebrae 1 to 4, respiratory paralysis is common, and the client requires ventilator assistance to breathe. Injuries below cervical vertebrae 4 may increase risk of respiratory failure which increased needs to respiratory care [7].

Surgical management of CCI may be indicated in the cases of progressive neurologic deficit, suspected epidural hematoma, bony fragments, or penetrating injuries that need surgical debridement, or to permit direct visualization and exploration of the cord. It includes many surgical techniques that include a decompression laminectomy, immobilization, and reduction of dislocations, stabilization of the vertebral column, a spinal fusion, and insertion of metal rods. Patients need intensive care management, nurses of cervical cord injured patients must have knowledge and skills to perform specific care for those patients [7].

Evidence based nursing practice support nurses to meet the needs of the patients with CCI to be managed in a continuum of care, through initial period of management and rehabilitation that are designed to meet the needs of patients [8]. Evidence based nursing is a process in which a nurse can make appropriate clinical decisions by using the available research conditions, clinical skill. The role of nursing care, which is established and performed based on evidence based guideline is very effective in managing diseases and even preventing problems for the patients with acute CCI. Evidence based nursing guidelines are golden standards for providing nursing care based on the best research evidence, clinical experiences, valid research evidences, patient`s view and values. Evidence based nursing guidelines for interventional technique in the management of patients will be developed to improve quality of care, treatments outcomes, and appropriateness of care [9].

The role of nursing care, which is established and performed based on evidence based performance principles and standard guidelines are very effective in managing CCI and even preventing problems for patients. The nurse plays an important role in implementing evidence based nursing guidelines for cervical cord injured patients and evaluating the effect of implementing these interventions which can improve maximum neurological recovery and independence, management of pain, safe functioning of the various systems of the body and prevention of complications in both short and long term [8].

The nurse also helps patient to adapt to an altered lifestyle, designs and implements treatment strategies based on scientific nursing theory and evidence based practice guidelines related to emergency care, self care, and promotes physical, psychosocial health. However, critical care nurses should implement management strategies based on evidence based nursing practice, scientific nursing theory to improve patients' functional status by minimizing symptoms and complications that affect quality of life, response to treatment [10]. Therefore the aim of this study was to evaluate the effect of implementing evidence based nursing practice guideline on clinical outcomes of patients with acute cervical cord injuries.

Aim of the study:
Evaluate the effect of implementing evidence based nursing practice guideline on clinical outcomes of patients with acute cervical cord injuries.

Research hypothesis:
- The study group who exposed to evidence based nursing practice guideline exhibited improve in respiratory status (normal breathing pattern, effective gas exchange, clearance of air way and normal oxygen saturation) than the control group who exposed to routine hospital care.
- The study group who exposed to evidence based nursing practice guideline exhibited improve in cardiovascular status (normal heart rate and blood pressure and maintance of circulation/perfusion) than the control group who exposed to routine hospital care.
- The study group who exposed to evidence based nursing practice guideline exhibited laboratory studies within normal range (arterial blood gases, complete blood count, and blood glucose level) than the control group who exposed to routine hospital care.
- The study group who exposed to evidence based nursing practice guideline exhibited normal vital signs than the control group who exposed to routine hospital care.
- The study group who exposed to evidence based nursing practice guideline exhibited improve nutritional status, maintance of fluids and electrolytes balance, and normal elimination pattern than the control group who exposed to routine hospital care.

- The study group who exposed to evidence based nursing practice guideline exhibited normal skin integrity, promotion of comfort, and decreased length of hospital stay in intensive care unit than the control group who exposed to routine hospital care.

II. Subjects And Method

Research design: Quasi experimental research design was utilized.

Setting: The study was carried out in Anesthesia Intensive Care Unit, affiliated to Tanta University Hospital, Tanta.

Subjects:

A convenience sample of (40) adult patients in the above previously mentioned setting was selected. The sample size was estimated using Epi Info 7 Statistical Program, using the following parameters: Total target population size=65 per year, confidence level=99.9%, expected frequency=50%, accepted error=5%, confidence co efficient=95%. The sample size was estimated to be 40 patients. They were divided into two equal groups, each group consisted of (20) patients as the following; **Study group:** They were managed with evidence based nursing

practice guideline. **Control group:** They were managed with routine intensive care.

Inclusion criteria: Adult patients with confirmed diagnosis of cervical cord injury. Immediately on admission within 24 hours. Patients with quadriplegia. **Exclusion criteria:** Patients with associated trauma in any other parts of the body or any other disorders.

Tools of the study: Three tools were utilized to collect pertent data.

Tool (I): Patients Cervical Cord Injury Assessment. It was developed by the researcher based on literature review [2, 5, 11, 12]. It was comprised of three parts;

Part (A) Sociodemographic characteristics; as age, sex, level of education, occupation.

Part (B): Patient`s clinical assessment; it includes data about date of admission, diagnosis, past medical and surgical history, oxygen received, vital signs, level of consciousness.

Part (C): Laboratory assessment; it includes data about: arterial blood gases as PaO_2, $PaCo_2$, and PH, complete blood count, blood glucose level, blood urea nitrogen, creatinine, and coagulation studies.

- Data obtained compared against normal values.

Tool (II)*: Muscle Strength and Sensory Assessment for Cervical Cord Injured Patients. It was developed by the **American Spinal Injury Association in 1973**[13]. It was comprised of two parts; muscle strength and sensory assessment.

Part (A): Muscle Strength Assessment: Muscle strength testing was based on estimation of muscle strength in ten key groups of muscles correlated to spinal cord segments on each side of the body, each side of the body is graded independently. Example: cervical vertebrae 5 cover the elbow flexors; biceps brachii and brachialis, cervical vertebrae 7 cover elbow extensors; triceps.

Scoring system: It was scored on a scale of 0–5 as follows: (0) indicate total paralysis, (1) indicate palpable contraction, (2) indicate active movement gravity eliminated. (3) indicate active movement against gravity, (4) indicate active movement against gravity with some resistance, (5) indicate active movement against gravity with normal resistance, and total score was 20.

Part (B): Sensory Assessment: A total of (28) key sensory points was assessed based on dermatome map, which is area of skin innervated by particular segment of spinal cord, it was assessed by pin pricking of specified area. Example: cervical vertebrae 2 dermatome covers the occiput and the top part of the neck, cervical vertebrae 3 dermatome covers the supraclavicular fossa and midclavicular line.

Scoring system: It scored as follows; (0) Indicate no sensation, (1) Indicate altered, either sensation or hypersensitivity sensation, (2) Indicate full sensation, and total score was 14.

Tool (III): Clinical Outcomes assessment Scale for Cervical Cord Injured Patients. It was developed by the researcher based on literature review [5, 11, 12, 14], to evaluate the acute CSCI patients' clinical outcomes. It was divided into (9) categories included the following: **Ventilation evaluation:** as respiratory rate, respiratory rhythm, depth of inspiration, chest expansion symmetrical, and ease of breathing. **Air way and gas exchange evaluation:** as ease of breathing, free of adventitious breath sounds, O_2 saturation, and moves of sputum out of airway. **Deep vein thrombosis evaluation:** as capillary refill and limb edema. **Impaired physical mobility evaluation:** as bed sores, deep vein thrombosis, chest infection, urinary retention and infection evaluation. **Nutrition, fluid and electrolyte evaluation. Urinary elimination evaluation:** as elimination pattern, urine amount, urine color, urine odor, recognize urge to void, empties bladder completely, absence of urine leakage, and absence of urinary tract infection. **Bowel evaluation:** as presence of constipation or diarrhea, stool color, and ease of stool passage. **Integumentary evaluation:** as skin intactness, skin temperature, and presence of skin lesions. **Thermoregulation evaluation:** as body temperature, muscle aches, sweating, and shivering.

Ethical and Legal Consideration:
• Official letters from the faculty of nursing were delivered to the appropriate authorities in the selected area to conduct the study.
• An informed consent was obtained from every patient if he/she is conscious or from his family if the patient is unconscious after explanation the aim of the study.
• Right to withdrawal from the study at any time without any rationale.
• Confidentiality of the data and patient privacy were respected. A code number was used instead of name.
• Patient anonymity was respected.

Methods of data collection
1. Tool I and III were developed by the researcher after extensive review of the relevant literatures. Tool II was developed by the American Spinal Injury Association, 1973 [13].
2. Three tools of data collection were translated into Arabic language because the study subjects had different levels of education.
3. All tools were tested for content validity by three panels of experts in the field of critical care nursing and two in neurosurgery.
4. All tools were tested for reliability using Cronbuch`s alpha test. It was 0.88 for tool I, 0.95 for tool II, and 0.85 for tool III.
5. Pilot study was conducted on (10%) of the patients to test feasibility, clarity, validity and applicability. Data obtained from the pilot study was excluded from the current study.
6. A convenience sample of 40 patients was selected and divided equally into two equal groups; study group was received evidence based nursing guidelines, control group was received only routine intensive care.
7. Data collection was done firstly for control group and then to study group to prevent data contamination.
6. Data collection for the present study was conducted within the period from the end of December 2017 to the end of August 2018.

8. The study was conducted through four phases:
1. Assessment phase:
Assessment of patient`s baseline data was carried out using tool I to assess sociodemographic characteristics (age, sex, and educational level), clinical data (past medical and surgical history and vital signs) and laboratory data (arterial blood gases and complete blood count), and II to evaluate muscle strength (cervical vertebrae 7 cover elbow extensors; triceps) and sensory assessment (cervical vertebrae 3 dermatome covers the supraclavicular fossa and midclavicular line) for both control and study groups pre application of evidence based nursing practice guideline immediately on admission.

11. Planning phase:
Evidence based nursing practice guideline were designed based on the study subjects' assessment and a guideline that is available in the relevant literature review **Taheri et. al, (2015)** [15] and it was applied by the researcher. Also, priorities and expected outcomes were formulated. A colored booklet was formulated and distributed for patients and family for reinforcement of information.

Expected outcomes: -
• Improve respiratory status (normal breathing pattern, effective gas exchange, air way clearance and normal oxygen saturation).
• Improve cardiovascular status (normal heart rate and blood pressure and maintance of circulation/perfusion).
• Laboratory studies within normal.
• Normal vital signs.
• No physical signs of malnutrition.
• Maintain fluids and electrolytes balance.
• Normal elimination pattern.
• Maintain skin integrity.
• Promotion of comfort.
• Decrease the period of hospitalization.

III. The implementation phase:

Study group Evidence based nursing practice guideline was applied by the researcher from the date of admission for three consecutive weeks in the morning shift, while in the afternoon and night shifts it was applied by the professional nurses in the critical care unit after they were trained by the researcher. The content of evidence based nursing practice guideline for cervical cord injured patients was applied according to nursing process; which were included: nursing diagnosis, expected outcomes, and nursing interventions based on review of literature **Taheri et. al, (2015)** [15] and patients assessment.

1. Nursing diagnosis: Ineffective breathing pattern related to: Impaired lung/chest wall expansion.
Nursing interventions: Assessing signs and symptoms of ineffective breathing pattern. Suction was done every two hours for 5 minutes. Oxygen was administered. Incentive spirometry was performed for conscious patient every hour. Deep breathing and coughing exercises was done every two hours for conscious patient.

2. Nursing diagnosis: Altered tissue perfusion related to: Decreased cardiac output and peripheral pooling of blood.
Nursing interventions: Assessing signs and symptoms of diminished tissue perfusion. Activities that cause vagal stimulation e.g. suctioning were avoided unless absolutely necessary. Actions that increase venous return were followed such as: Range of motion exercises. Positions that compromise blood flow in the lower extremities were avoided e.g. pillows under knees. Apply thigh-high elastic stockings every two hours and remove for 30-60 minutes twice daily. Elevate lower extremities for 20-minute intervals 6 times per shift.

3. Nursing diagnosis: Disturbed Sensory Perception related to: Destruction of sensory tracts with altered sensory reception, transmission, and integration.
Nursing interventions: Assessing sensory function. For conscious patient, note presence of exaggerated emotional responses and altered thought processes. Save surrounding environment from bodily harms. Tactile stimulation, touching conscious patient was done in intact sensory areas e.g., shoulders, face, and head. Talk to conscious patient frequently and use clocks, calendars, pictures.

4. Nursing diagnosis: Impaired physical mobility related to: activity limitations associated with quadriplegia and spasticity following the period of spinal shock.
Nursing interventions: Assessing motor function. For conscious patient, active-resistive exercises for non affected parts of neck, shoulders, and biceps was done 4 times per day for 10 minutes and passive range of motion was done 4 times per day for 10 minutes to areas below the level of the cord injury. For unconscious patients, passive range of motion exercises was done 4 times per day for 10 minutes for non affected parts of neck, shoulders, and biceps and areas below the level of the cord injury. Arms and ankles were positioned at 90 degree angle every 4 hours. Lower extremities were assessed each shift for thrombophlebitis and edema. Blood pressure was measured before and after activity in acute phases.

5. Nursing diagnosis: Impaired skin integrity related to: immobility, damage to the skin associated with friction or shearing.
Nursing interventions: Skin was assessed every 4 hours. Changing position was done every 2 hours from lateral to prone to supine position. Bathing by using mild soap and warm water was done once a day. Halo or tong insertion sites were cleansed every shift and antibiotic ointment was applied. Skin massage and lubrication of skin with oil was done every 2 hours. Pressure points were protected by use of air mattress and heel and elbow pads. Bed linens were kept dry and wrinkle-free.

6. Nursing diagnosis: Altered nutrition less than body requirements related to: Decreased oral intake.
Nursing interventions: Assessing signs and symptoms of malnutrition every day. Nasogastric tube was attached on low suction. Enteral nutrition was administered within 24 hours post admission. Oral care was performed every 4 hours. Tube placement was checked before starting each feeding. Head of bed was elevated at 30^0-40^0 degree during and after feeding. Gastric residual was checked every 4 hours. Flushing of tube with 30ml of water was done before and after feeding administration.

7. Nursing diagnosis: Disturbed sleep pattern related to: inability to assume usual sleep position, fear and anxiety, and unfamiliar environment.
Nursing interventions: Assessing signs and symptoms of a sleep pattern disturbance. Patient`s usual sleep habits were determined. Comfortable sleep position was assumed. Comfort and warmth were provided before sleep. Back massage was applied before sleep. Good room ventilation was ensured. Quiet environment and limit visitors.

8. Nursing diagnosis: Ineffective thermoregulation related to: loss of nervous system feedback between the area below the level of cord injury and the hypothalamus.
Nursing interventions: Assessing for signs and symptoms of ineffective thermoregulation. Patient`s temperature was assessed every 2 hours. If there is hypothermia: Extra clothing and bedding were applied, protect patient from drafts, and warming blanket was used. If there is hyperthermia: Excessive clothing and bedding were removed, cooling blanket was used, extra clothing during physical and occupational therapy sessions was removed.

9. Nursing diagnosis: Altered urinary elimination Retention related to: Atony of bladder wall, and spasticity of the external urinary sphincter.

Nursing interventions: Assess signs and symptoms of urinary retention e.g. bladder distention. Urinary catheterization was applied for all patients under aseptic technique. Catheter tubing was kept free of kinks. Perineal care was done every shift and after each bowel movement. Catheter tubing was secured to lower abdomen or thigh on males or to thigh on females. Urine collection container was kept below bladder level at all times.

10. Nursing diagnosis: Constipation Related to: decreased gastrointestinal motility, and loss of central nervous system control over defecation reflex.

Nursing interventions: Assessing signs and symptoms of constipation. Bowel sounds was auscultated every 6 hours. Privacy and adequate ventilation was provided. Bowel program by using digital stimulation and stool softeners are used daily every shift. Ample time for bowel evacuation take up to an hour after rectal stimulation was provided.

Control group received the routine intensive care unit care that provided by the nurses in the unit as the following; apply oral and tracheal suction. administer enteral nutrition within 24 hours post admission according to patient`s feeding test and gastric residuals, check vital signs every 2 hours, measure intake and output daily, elevate head of bed to 30 degrees, change position of patient every shift, make hygienic care every shift.

V. The evaluation phase:

- Evaluation was done for both study and control groups by using tool II to evaluate muscle strength (cervical vertebrae 5 cover the elbow flexors) and sensory assessment (cervical vertebrae 2 dermatome covers the occiput and the top part of the neck) once pre implementation and at the end of first week and third week. Also, tool III to evaluate clinical outcomes such as ventilation evaluation (respiratory rate and rhythm), deep vein thrombosis evaluation (capillary refill and limb edema), urinary elimination evaluation (elimination pattern, urine amount, color, and odor) once pre implementation and at the end of first week and third week.

- Comparison was done between both groups to evaluate the effect of implementing evidence based nursing practice guideline on clinical outcomes of patients with acute cervical cord injuries.

Statistical Analysis: Data was collected then tabulated and statistically analyzed using Statistical Package for Social Sciences (SPSS) version 25. Descriptive statistics (frequency, percentage) were used to describe patient's characteristics and clinical outcomes. While correlation a coefficient, a statistically significant difference was adopted at p-value $p \leq 0.05$ [16].

III. Results
Table (1): Sociodemographic characteristics of patients with acute cervical cord injury.

Characteristics	The studied patients (n=40)				χ^2 P
	Control group(n=20)		Study group(n=20)		
	N	%	N	%	
Age in years:					
▪ 21-	4	20.0	4	20.0	0.139
▪ 30-	11	55.0	10	50.0	0.933
▪ 40-	5	25.0	6	30.0	
Range	(22-45)		(25-48)		t=0.835
Mean ± SD	34.85±6.23		36.60±6.99		P=0.409
Sex					
▪ Male	14	70.0	14	70.0	FE
▪ Female	6	30.0	6	30.0	1.00
Educational level					
▪ Illiterate	4	20.0	6	30.0	
▪ Read and write	1	5.0	2	10.0	
▪ Elementary/prepara tory	1	5.0	1	5.0	1.333
▪ Secondary	5	25.0	5	25.0	0.856
▪ University/higher	9	45.0	6	30.0	
Occupation					
▪ Not working					
▪ Manual work	2	10.0	1	5.0	
▪ Employee	10	50.0	10	50.0	
▪ Technical work	5	25.0	6	30.0	0.424
▪ House wife	1	5.0	1	5.0	0.980
	2	10.0	2	10.0	

Marital status					
• Single	4	20.0	4	20.0	FE
• Married	16	80.0	16	80.0	1.00

Table (1): Sociodemographic characteristics of the studied patients. Regarding age, it was observed that more than half (55%) and half (50%) of the control and study groups respectively, were in the age group of 30-<40 years.

Additionally, it was found that the mean age of control and study groups were 34.85±6.23 and 36.60±6.99 respectively. Also, this table shows more than two third (70%) of the patients in both control and study groups were male.

Regarding marital status, these findings showed that the majority (80%) of patients in both control and study groups were married.

Table (2):- Percentage distribution of patients of both study and control group according to clinical data.

Clinical assessment	The studied patients(n=40)				χ^2 P
	Control group(n=20)		Study group(n=20)		
	N	%	N	%	
Past medical history					
• None	14	70.0	14	70.0	
• Respiratory diseases	2	10.0	2	10.0	2.00
• Renal diseases	3	15.0	1	5.0	0.572
• Diabetic disease	1	5.0	3	15.0	
Past surgical history					
• None	15	75.0	13	65.0	
• Appendectomy	2	10.0	4	20.0	2.00
• Hysterectomy	1	5.0	0	0.0	0.572
• hernia	2	10.0	3	15.0	
Oxygen received					
• Simple mask	4	20.0	3	15.0	FE
• Mechanical ventilator	16	80.0	17	85.0	1.00

Table (2): Percentage distribution of patients of both study and control group according to clinical data. In relation to past medical and surgical history, more than two third (70%) and (75% and 65%) of the patients in both control and study groups had no previous diseases and surgery respectively.

Also, it was found that the majority (80%) and (85%) of control and study groups were on mechanical ventilator respectively.

Table (3): Percent distribution of the studied patients of both groups according to vital signs throughout the study period.

Vital signs	The studied patients (n=40)													
	Control group (n=20)						χ^2 P	Study group (n=20)						χ^2 P
	Pre Implementation		At the end of 1st week post implementation		At the end of 3rd week post Implementation			Pre implementation		At the end of 1st week post implementation		At the end of 3rd week post Implementation		
	N	%	N	%	N	%		N	%	N	%	N	%	
1. Respiratory rate														
• Normal	16	80.0	16	80.0	16	80.0	0.000	17	85.0	20	100.0	20	100.0	**6.316**
• Tachypnea	4	20.0	4	20.0	4	20.0	1.00	3	15.0	0	0.0	0	0.0	**0.043***
Control VS Study χ^2 , P			FE , 0.106		FE , 0.106									
2. Heart rate														
• Normal	17	85.0	16	80.0	12	60.0	3.733	17	85.0	20	100.0	20	100.0	**6.316**
• Bradycardia	3	15.0	4	20.0	8	40.0	0.155	3	15.0	0	0.0	0	0.0	**0.043***
Control VS Study χ^2 , P			FE , 0.106		**FE , 0.003***									
3. Blood pressure														
• Normal	13	65.0	12	60.0	7	35.0	4.152	13	65.0	20	100.0	20	100.0	**15.85**
• Hypotension	7	35.0	8	40.0	13	65.0	0.125	7	35.0	0	0.0	0	0.0	**0.000***
Control VS Study χ^2 , P			**FE , 0.003***		**FE , 0.000***									
4. Temperature														
• Normal	14	70.0	9	45.0	11	55.0	8.527	14	70.0	17	85.0	20	100.0	**10.06**
• Hyperthermia	3	15.0	10	50.0	9	45.0	0.074	3	15.0	3	15.0	0	0.0	**0.039***
• Hypothermia	3	15.0	1	5.0	0	0.0		3	15.0	0	0.0	0	0.0	
Control VS Study χ^2 , P			**26.117 , 0.000***		**FE , 0.000***									

Table (3): Percent distribution of the studied patients of both groups according to vital signs throughout the study periods. In relation to respiratory rate and heart rate at the end of 3rd week, it was observed that all patients (100%) of study group had normal respiratory and heart rate compared to their control (80% and 60%) respectively with significant differences among study group regarding respiratory rate and heart rate throughout their period of study, where P= (0.043*, 0.043*).

On the other hand, no significant differences were observed between control and study group regarding respiratory rate and a significant difference was observed regarding heart rate between control and study group F.E (0.003). Also, this table illustrated that at the end of 3rd week all patients (100%) of study group had normal blood pressure and temperature measurement compared with (35% and 55%) of control group patients.

Significant differences among study groups regarding blood pressure and body temperature observed where P= (0.000*, 0.039*). Also, significant differences were observed among control and study groups regarding blood pressure and temperature, where P= (0.000*, 0.000*).

Table (4): Percent distribution of muscle strength and sensory assessment for patients with acute cervical cord injury throughout the study period for both groups.

	The studied patients(n=40) Range/Mean ± SD													
	Control group(n=20)							Study group(n=20)						
Items	Pre Implementation		At the end of 1st week post Implementation		At the end of 3rd week post Implementation		F P	Pre implementation		At the end of 1st week post Implementation		At the end of 3rd week post implementation		F P
	Right	Left	Right	Left	Right	Left		Right	Left	Right	Left	Right	Left	
A. Muscle strength assessment														
1. Elbow flexors	0.80±1.32	0.80±1.32	0.80±1.32	0.80±1.32	0.80±1.32	0.80±1.32	0.00 1.00	1.40±1.54	1.40±1.54	1.40±1.54	1.40±1.54	1.40±1.54	1.40±1.54	0.00 1.00
2. Elbow extensors	1.25±1.48	1.25±1.48	1.25±1.48	1.25±1.48	1.25±1.48	1.25±1.48	0.00 1.00	1.30±1.34	1.30±1.34	1.30±1.34	1.30±1.34	1.30±1.34	1.30±1.34	0.00 1.00
3. Wrist extensors	1.25±1.48	1.25±1.48	1.25±1.48	1.25±1.48	1.25±1.48	1.25±1.48	0.00 1.00	1.50±1.57	1.50±1.57	1.50±1.57	1.50±1.57	1.50±1.57	1.50±1.57	0.00 1.00
4. Finger flexors	1.25±1.48	1.25±1.48	1.25±1.48	1.25±1.48	1.25±1.48	1.25±1.48	0.00 1.00	1.30±1.34	1.30±1.34	1.30±1.34	1.30±1.34	1.30±1.34	1.30±1.34	0.00 1.00
B. Sensory Assessment														
1. Occiput and the top part of the neck.	0.65±0.75	0.65±0.75	0.65±0.75	0.65±0.75	0.65±0.75	0.65±0.75	0.00 1.00	0.85±0.75	0.85±0.75	0.85±0.75	0.85±0.75	0.85±0.75	0.85±0.75	0.00 1.00
2. Lower part of the neck to the clavicle bone.	0.95±0.83	0.95±0.83	0.95±0.83	0.95±0.83	0.95±0.83	0.95±0.83	0.00 1.00	0.85±0.75	0.85±0.75	0.85±0.75	0.85±0.75	0.85±0.75	0.85±0.75	0.00 1.00
3. Area just below the clavicle.	0.95±0.83	0.95±0.83	0.95±0.83	0.95±0.83	0.95±0.83	0.95±0.83	0.00 1.00	0.85±0.75	0.85±0.75	0.85±0.75	0.85±0.75	0.85±0.75	0.85±0.75	0.00 1.00
4. Lateral arm at and above the elbow.	0.45±0.51	0.45±0.51	0.45±0.51	0.45±0.51	0.45±0.51	0.45±0.51	0.00 1.00	0.65±0.59	0.65±0.59	0.65±0.59	0.65±0.59	0.65±0.59	0.65±0.59	0.00 1.00
5. Forearm and the radial side of the hand.	0.45±0.51	0.45±0.51	0.45±0.51	0.45±0.51	0.45±0.51	0.45±0.51	0.00 1.00	0.60±0.50	0.60±0.50	0.60±0.50	0.60±0.50	0.60±0.50	0.60±0.50	0.00 1.00
6. Middle finger.	0.45±0.51	0.45±0.51	0.45±0.51	0.45±0.51	0.45±0.51	0.45±0.51	0.00 1.00	0.60±0.50	0.60±0.50	0.60±0.50	0.60±0.50	0.60±0.50	0.60±0.50	0.00 1.00
7. Lateral aspects of the hand.	0.45±0.51	0.45±0.51	0.45±0.51	0.45±0.51	0.45±0.51	0.45±0.51	0.00 1.00	0.60±0.50	0.60±0.50	0.60±0.50	0.60±0.50	0.60±0.50	0.60±0.50	0.00 1.00

* Significance at level P < 0.05.

Table (4): Percent distribution of muscle strength and sensory assessment for patients with acute cervical cord injury throughout the study period for both groups. Results showed no statistical significant differences was observed pre implementation and at the end of the study for both control and study groups, where P= (≥0.05).

Table (5): Percent distribution of the control and study group patients with acute cervical spinal cord injury according to deep vein thrombosis assessment throughout the study period.

	The studied patients (n=40)													
	Control group (n=20)							Study group (n=20)						
Items	Pre Implementation		At the end of 1st week post implementation		At the end of 3rd week post implementation		χ^2 P	Pre implementation		At the end of 1st week post implementation		At the end of 3rd week post implementation		χ^2 P
	N	%	N	%	N	%		N	%	N	%	N	%	
A. Deep vein thrombosis (DVT)	0	0.0	0	0.0	4	20.0	18.462 0.00*	0	0.0	0	0.0	0	0.0	-
Control VS Study χ^2, P				-		FE , 0.003*								
B. Capillary refill														
▪ Normal	19	95.0	14	70.0	13	65.0	17.243 0.00*	13	65.0	20	100.0	20	100.0	15.85 0.00*
▪ Delayed > 2 seconds	1	5.0	6	30.0	7	35.0		7	35.0	0	0.0	0	0.0	
Control VS Study χ^2, P			FE , 0.020*		FE , 0.000*									
C. Lower limb edema	0	0.0	0	0.0	9	45.0	21.176 0.000*	0	0.0	0	0.0	0	0.0	-
Control VS Study χ^2, P				-		FE , 0.001*								

FE: Fisher' Exact test   *   Significance at level P < 0.05.

Table (5): Distribution of patients with acute cervical cord injury according to deep vein thrombosis assessment throughout the study period. Concerning deep vein thrombosis, it was observed that (20%) of control group had deep vein thrombosis compared with none of study group at the end of 3rd week with a

significant difference among control group throughout the study period, where P= (0.00*). In addition, the table showed that all patients (100%) of the study group had normal capillary refill compared to their control (65%) at the end of 3rd week with a significant difference among control and the study groups, where P=(0.00*, 0.000*). Also, this table reported that less than half (45%) of the control group had lower limb edema compared with none of study group with a significant difference between both groups, where P= (0.001*) at the end of 3rd week and a significant differences was observed among control group at the end of 3rd week, where P= (0.000*).
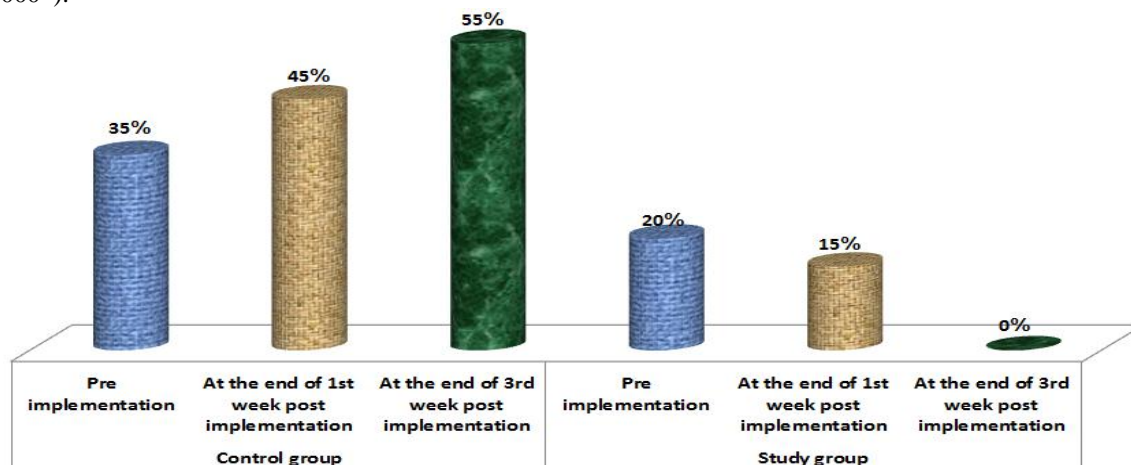
Figure (1): Percent distribution of patients of both groups with acute cervical cord injury according to chest infection throughout the study period.

Figure (1): Percent distribution of patients of both groups with acute cervical cord injury according to chest infection throughout the study period. More than one third (35%) of control group reported chest infection and the percentage increased at the end of 1st week to reach (45%) and in the 3rd week to (55%).

On the other hand, (20%) of the study group reported chest infection and the percentage decreased at the end of 1st week to reach (15%) and no one at the third week had chest infection with a significant difference between both groups.
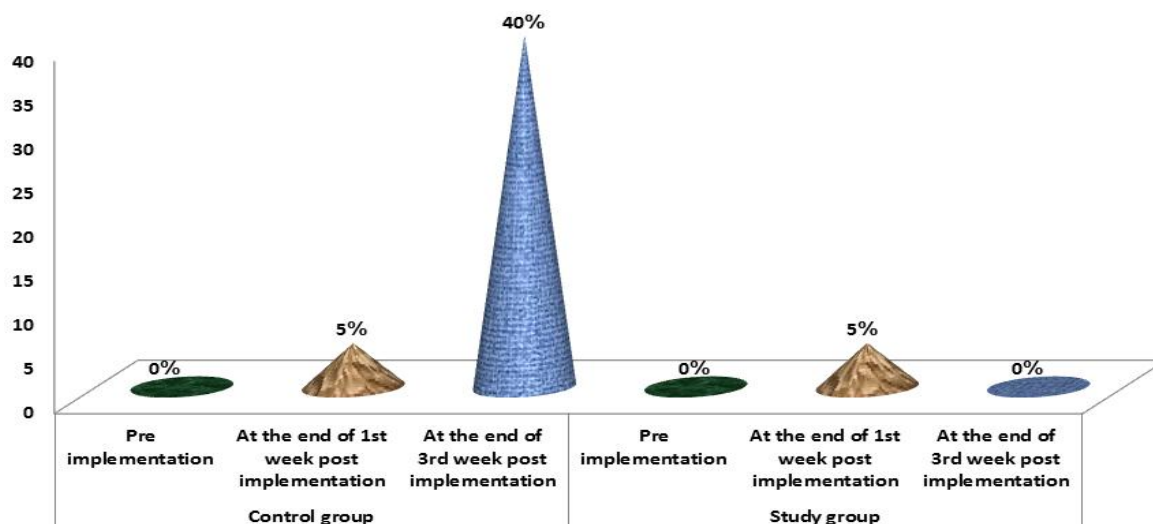

Figure (2): Percent distribution of patients of both groups with acute cervical cord injury according to urinary tract infection throughout the study period.

Figure (2): Distribution of patients of both groups with acute cervical cord injury according to urinary tract infection throughout the study period. It was found that no one of control group reported urinary tract infection and the percentage increased at the end of 1st week to reach (5%) and in the 3rd week to (40%).

On the other hand, no one of the study group reported urinary tract infection and the percentage increased at the end of 1st week to reach (5%) and no one in the third week had urinary tract infection with a significant difference between both groups.

Table (6): Percent relation between the age of the studied patients and deep vein thrombosis assessment for acute cervical cord injured patients among the studied groups at the end of 3rdweek post implementation.

Deep vein thrombosis Evaluation	Age (in years) At the end of 3rd week post implementation													
	Control group (n=20)						χ² P	Study group (n=20)						χ² P
	(21-< 30) Years		(30-<40) years		(40-< 50) years			(21-< 30) Years		(30-<40) Years		(40-< 50) Years		
	N	%	N	%	N	%		N	%	N	%	N	%	
A. Deep vein thrombosis (DVT)	3	15.0	3	15.0	2	10.0	2.784 0.249	0	0.0	0	0.0	0	0.0	-
B. Capillary refill • Normal • Delayed > 2 seconds	0 4	0.0 20.0	0 11	0.0 55.0	0 5	0.0 25.0	-	4 0	20.0 0.0	10 0	50.0 0.0	6 0	30.0 0.0	-
C. Lower limb edema	3	15.0	4	20.0	2	10.0	1.837 0.399	0	0.0	0	0.0	0	0.0	-

Table (6): Percent relation between the age of the studied patients and deep vein thrombosis assessment for acute cervical cord injured patients among the studied groups at the end of 3rd week post implementation**.** The table revealed that no significant correlation was found between study and control groups in relation to deep vein thrombosis and their age post implementation of evidence based nursing practice guideline.

Table (7): Percent relation between the body mass index level of the studied patients and integumentary assessment for acute cervical cord injured patients among both studied groups at the end of 3rdweek post implementation.

Integumentary Assessment	Body mass index level At the end of 3rdweek post implementation													
	Control group(n=20)						χ² P	Study group(n=20)						χ² P
	Normal weight		Overweight		Obesity			Normal weight		Overweight		Obesity		
	N	%	N	%	N	%		N	%	N	%	N	%	
A.1. Skin intactness • Intact • Presence of skin lesions	1 2	5.0 10.0	6 5	30.0 25.0	4 2	20.0 10.0	0.90 0.638	4 0	20.0 0.0	11 2	55.0 10.0	3 0	15.0 0.0	1.197 0.550
A.2. # Type of skin lesions. 1- Abrasion. 2- Bruising 3- Hematoma	2 1 1	10.0 5.0 5.0	3 5 1	15.0 25.0 5.0	1 2 0	5.0 10.0 0.0	0.303 0.859	0 0 0	0.0 0.0 0.0	0 0 1	0.0 0.0 5.0	0 0 0	0.0 0.0 0.0	-
B. Skin temperature • Normal • Cool • Warm	0 0 3	0.0 0.0 15.0	0 0 11	0.0 0.0 55.0	0 0 6	0.0 0.0 30.0	-	4 0 0	20.0 0.0 0.0	13 0 0	65.0 0.0 0.0	3 0 0	15.0 0.0 0.0	-

#More than one answer was chosen

Table (7): Percent relation between the body mass index level of the studied patients and integumentary assessment for acute cervical cord injured patients among studied groups at the end of 3rd week post implementation. The table revealed that no significant correlation was found between study and control groups in relation to integumentary assessment and their body mass index level post implementation of evidence based nursing practice guideline.

IV. Discussion

Cervical cord injury is a sort of higher disabling injury; it is not only can lead to damage or loss of sensation and motor function, but also may lead to multiple organ dysfunctions [5]. Guideline that was developed for management of patients with acute cervical cord injury have multiple function of the body [15]. Critical care nurses have a vital role during care of patients with acute cervical cord injury because they cognitively manipulate many variables over a continuum of care and if such tasks are skillfully and successfully performed, the incidence rate of secondary spinal cord injury is reduced [7]. This study aimed to evaluate the effect of implementing evidence based nursing guideline on clinical outcomes of patients with acute cervical cord injuries

Regarding sociodemographic characteristics, the finding of the present study revealed that the most common age among patients of both studied groups was between third and fourth decade of life. This result was

in same line with **Salman et al (2019)** [17] reported that most of the cervical cord injured patients were young adults and their age between 20-39 years. Also the present study showed that more than two third of the patients in both study and control groups were males and less than half of patients in both groups have university/higher education. This result was in congruent with **Umana et al (2018)** [18] who mentioned that the majority of studied patients were males. Moreover **Fuseini (2019)** [19] reported that most of the spinal cord injured patients have university/higher education.

Concerning occupation and marital status, the current study revealed that half of patients with acute CCI in both groups have manual work and majority of them had been married. This result was in the same line with **Debebe et al (2016)** [20] who reported that most of the studied patients with acute cervical cord injury have manual work. This result was contradicted with **Shao et al (2011)** [21] who pointed out that most of the studied patients with cervical spinal cord injury were white collar workers. This result was consistent with **Reza et al (2014)** [22] who stated that the majority of studied patients with cervical cord injuries were married.

Regarding past medical and surgical history, the current study revealed that most patients in both groups had no previous diseases and surgery and the majority of them were on mechanical ventilator. This could be due to increasing breathing activity, which results in respiratory fatigue and may need intubation for mechanical ventilation. This result was in the congruent with **Verin (2017)** [23] who stated that the majority of cervical cord injured patients had no past medical and surgical history. This result was in contrast with a result study, **Wong (2012)** [24] reported that the acute cervical spinal cord injured patients had pre morbid history of chronic disease, and there is no previous surgical history. This result was supported by **Harvin et al (2016)** [25] who mentioned that all the cervical cord injured patients had tracheostomy and were on mechanical ventilator.

In relation to the effect of evidence based nursing guidelines on respiratory rate, the present study revealed that there were a statistically significant improvement in patient`s respiratory rate post implementation of evidence based nursing practice guideline in the study group than control group. This could be due to paralysis of the respiratory muscles that increases patient risk for respiratory failure and respiratory complications after cervical cord injury. It includes hypercapnea, hypoventilation, decrease in surfactant production, increase mucus production, higher respiratory rate and effort, atelectasis, and pneumonia. This result was in the same line with **Shehab M (2018)** [26] who reported that most of cervical cord injured patients have a statistically significant improvement in respiratory rate post implementation of resistive respiratory muscle training. This result was in contrast with **Berlowitz et al (2016)** [27] who reported that the majority of cervical cord injured patients had irregular respiratory rate.

As regards to the effect of evidence based nursing practice guideline on the heart rate, there was a statistically significant improvement in heart rate post implementation of evidence based nursing practice guideline. This could be due to the cardiovascular management was used as nursing interventions to improve homodynamic condition. This result was supported by **Legg et al (2018)** [28] stated that the majority of cervical cord injured patients have a statistically significant improvement in heart rate post implementation of respiratory muscle training. This result was contradicting with **Thayer et al (2016)** [29] who founded that cervical cord injured patients with destruction at the spinal sympathetic pathways have a significant disruption in baroreflex control of blood pressure and heart rate.

Concerning blood pressure; the present study reported there was a statistically significant improvement in blood pressure post implementation of evidence based nursing practice guideline. This may be attributed to sudden loss of smooth muscle autonomic effect in the walls of the blood vessels, and vasodilatation occurs as a result, the acute loss of sympathetic stimulation leads to bradycardia, during the acute phase, the arterial hypotension may be misinterpreted as loss of volume. This result was in agreement with **Currie et al (2016)** [30] who reported that all patients with cervical cord injury have good blood control. This result was in contrast with **Saadeh et al (2017)** [31] who reported that the majority of acute cervical cord injured patients have blood pressure control.

In relation to body temperature, the current study showed a statistically significant improvement in body temperature post implementation of evidence based nursing practice guideline. This could be due to the insult of injury; the acidosis and hypercapnia evident in cervical cord injury that develop in heat stroke further impaired thermoregulation and increased coagulopathy. This result was in accordance with **Yusuf et al (2019)** [32] who mentioned that the all the studied patients with spinal cord injury especially injury at cervical level have no hyperthermia and sepsis. This result was in congruent with **DeMuro et al (2013)** [33] reported that the rate of hyperthermia after cervical cord injury was successfully managed by using external cooling device.

As regards to muscle strength and sensory assessment, the current study showed that there was no statistical significant difference between control and study groups post implementation of evidence based nursing practice guideline. This result was in agreement with **Sewell et al (2018)** [34] who mentioned that delayed surgical decompression and stabilization for acute cervical cord injury was associated with late neurological recovery especially motor and sensory functions. This result was contradicted by **Jug et al (2015)**

[35] reported that the majority of traumatic cervical cord injured patients have a better improvement of motor and sensory function post treatment.

Concerning deep vein thrombosis, findings of the present study revealed that there were statistical significant difference in relation to deep vein thrombosis in the third week among control group while, study group had no deep vein thrombosis. This could be attributed to normovolemic status, administering low molecular weight heparin subcutaneously as a prophylactic dose, early mobility, and using antiembolic stocking. This result was in accordance with **Liu et al (2016)** [36] who pointed out that cervical spondylotic myelopathy patients who were scheduled for surgery often presented with deep vein thrombosis preoperatively and should be considered for those patients.

Also, the current finding illustrated that a statistical significant difference was observed in relation to a delayed capillary refill and lower limb edema in the third week among control group. This could be due to maintaining normovolemic condition, administering a subcutaneous low molecular weight heparin, used antiembolic stocking, range of motion exercise, and early mobility for study group. This result was in accordance with **Hagen et al (2012)** [37] who mentioned that the majority of cervical cord injured patients have vasodilatation, venous stasis and lower limb edema. This result was in contrast with **Arnold et al (2017)** [38] who pointed out that there was lower incidence of venous thromboembolism, lower limb edema, and delayed capillary time after using safe anticoagulant.

Concerning chest infection, the current study revealed that there was a statistical significant difference in the third week among the most of control group than study group. This result was in the same line with **Yang et al (2017)** [39] who founded that there was an increasing rate of respiratory infections after acute cervical cord injury. This result was in contrast with **Shank et al (2017)** [40] who founded that there was lower rate of respiratory complications such as respiratory failure after cervical cord injury.

In relation to urinary tract infection, the current study revealed that there was a statistical significant difference in the third week among the most of control group than study group. This result was in accordance with **Stampas et al (2019)** [41] who mentioned that there was a statistically significant correlation between acquired urinary tract infections and lower functional independence motor scores on admission, gain, and discharge. This result was contradicted by **Yue et al (2017)** [42] who emphasized that there was lower rate of urinary tract infection for acute cervical cord injured patients due to application of proper critical care for those patients.

Regarding correlation between age of the studied patients and deep vein thrombosis evaluation, findings of the present study showed that there was no significant correlation was found between study and control groups in relation to deep vein thrombosis and their age post implementation of evidence based nursing practice guideline. This result was in agreement with **Mackiewicz et al (2016)** [43] who pointed out that the higher rate of deep vein thrombosis and edema was presented in acute cervical cord injured patients with average age 30 years. Moreover, this result was contradicting with **Tomba et al (2016)** [44] who reported that the incidence of deep vein thrombosis after spinal cord surgery especially cervical spinal surgeries was more commonly high in old age.

As regards to correlation between body mass index of the studied patients and integumentary assessment, findings of the present study revealed that intact skin was found in higher rates in study group with normal weight than control group. This result was in agreement with **Rosenfeld et al (2013)** [45] who mentioned that cervical cord injured patients underwent surgery have been compromised and have poor surgical and medical outcomes mainly skin complications. This result was in contrast with **Hee et al (2015)** [46] revealed that body mass composition does not affect skin intactness directly in acute cervical cord injured patients.

V. Conclusion

Based on the results, it can be concluded that implementing evidence based nursing practice guideline has a positive effect on mean score of breathing pattern, effective gas exchange and clearance of air way, oxygen saturation, level of consciousness, circulation/perfusion, laboratory finding within normal range, and vital signs. It improve also nutritional status, fluids and electrolytes balance, elimination pattern, comfort, skin integrity, and length of hospital stay in intensive care unit.

Recommendations: Based on the result, it can be recommended that:
- The evidence based nursing practice guideline should be available in the intensive care unit.
- Patient's assessment should be carried out immediately post intensive care admission.
- Continuous monitoring for vital signs, cardiopulmonary and neurological system, nutrition, fluid and electrolyte, and skin.
- Colored illustrated booklet should be distributed to patients and their family.

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