

## Impact of Training Program About Management of Children In Hypovolemic Shock on Nurses' Knowledge And Performance: Evidence-Based Practice Guidelines

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### Abstract

**Aim of the Study:** This study aimed at assessing the impact of training program based on clinical guidelines for management of children in hypovolemic shock on nurses' knowledge and performance, as well as on the clinical outcome measures (discharge weight, length of hospital stay and mortality rate) of shocked children. **Study Design:** A quasi-experimental design was utilized. **Setting:** The study was carried out at Pediatric Emergency and Medical Departments/Pediatric Children's Hospital, affiliated to Ain Shams University Hospitals. **Subjects:** A convenience sample of 60 nurses who were provided care for children in hypovolemic shock in addition to 60 pediatric patients who were randomly divided into two equal groups; pre-intervention or usual care group, and post-intervention group were included in the study. **Data collection:** Four tools that consisted of an assessment questionnaire sheet about the characteristics of children and their medical data, a questionnaire sheet, observational checklists to assess nurses' knowledge and their practices pre- and post-implementation of the study training program, and the clinical guidelines about nursing management of children in hypovolemic shock were used. **Results:** The studied nurses' knowledge and their clinical performance regarding care of children in hypovolemic shock were significantly improved post implementation of the study training program. Furthermore, children in the post-intervention group showed a significant improvement in their clinical outcome measures immediately after implementation of the training program compared with the usual care group. **Conclusion:** Implementation of training program based on clinical guidelines about a hypovolemic shock management had a positive impact on the improvement of nurses' knowledge and their performance and on the clinical outcomes of children in hypovolemic shock. **Recommendations:** The study recommended On Job Training programs for the nurses according to their needs in order to refresh and update knowledge and improve their clinical performance for those critically ill children.

**Key words:** Hypovolemic Shock, Nurses, Training program, Evidence-based practice, Children.

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### I. Introduction

Hypovolemic shock is a common yet underappreciated insult which often accompanies illnesses afflicting children.<sup>[1,2]</sup> It is a serious life threatening condition characterized by hypo-perfusion of tissues which results from decreased blood volume (hypovolemia). Hypovolemic or hemorrhagic shock caused by blood loss from obvious trauma; occult bleeding from pelvic fractures, blunt abdominal trauma, or "shaken baby" which is a leading cause of morbidity and mortality in the pediatric population due to circulatory system failure to supply oxygen and nutrients to meet cellular metabolic demands.<sup>[3]</sup> Moreover, hypovolemic shock can be broadly caused by either decreased intake of fluid, excessive urinary losses or translocation of body fluid from the intravascular compartment. Additionally, fever and tachypnea, which accompany many pediatric illnesses, result in hypovolemia as a result of increased insensible fluid losses.<sup>[4,5]</sup>

Worldwide 10 million deaths annually are due to hypovolemia. Highest mortality is observed in under 5 children in developing countries.<sup>[6-8]</sup> Infants and young children commonly have hypovolemic shock that results from severe water loss through diarrhea, vomiting with poor oral intake, major burns, and diabetic ketoacidosis.<sup>[9]</sup> Diarrheal diseases resulting in dehydration account alone for approximately 30% of infant deaths worldwide, and it is estimated that 8,000 children younger than the age of five years die every day from untreated dehydration.<sup>[5]</sup> In one of the Egyptian University Burn Center, of the 516 patients admitted, 96 children died, giving an overall mortality rate of 18.6%. The main cause of death was multi-organ failure, which accounted for 48.1% of the mortality cases. Septicemia caused about 27% of deaths, burn shock led to 19.7% of deaths.<sup>[10]</sup>

Early recognition and treatment of shock is paramount to reversing cellular hypoxia and ischemia before irreparable end-organ damage ensues. Therefore, providing clinical guidelines in management of shock in children is considered one of the most promising and effective advances for early defining and improving the care for those children. However, their development, dissemination and implementation in practice are rarely straight forward. The use of guidelines also known as standing orders, preprinted order sets, advanced nursing interventions and computerized order sets, has been recognized as methods of enhancing safety, while expediting pediatric patient care.<sup>[11]</sup>

Also, training on implementing clinical guidelines developed for providing safe and appropriate care for children at risk for developing hypovolemic shock allow the health care provider (physician/nurse) to accurately assess and immediately initiate diagnostic tests and intervene early with children suffering from shock.<sup>[12]</sup> Furthermore, implementation of nursing training based on clinical guidelines about hypovolemic shock has been reported to decrease pediatric patient's length of stay in the hospital.<sup>[13]</sup>

Emergency nurses in pediatric care settings should be trained on using nursing protocol that is based on evidences, and contains details of practical procedures for management of different degrees and types of shock; including administration of medication and fluid resuscitation. Moreover, pediatric nurses who are involved in critical care settings should be able to demonstrate continuous professional development in the specialty by attendance of local and national scientific meetings/conferences in addition to suitable On the Job Training (OJT) courses that are based on their needs.<sup>[14]</sup>

### **Significance of the study**

In the developed countries, hypovolemic shock still accounts for 10-20% of hospital admissions of infants and young children.<sup>[5]</sup> In Egypt, death among volume depleted children with diarrheal disease is the second leading cause of death among the under-five children. The survival of a child with severe volume depletion at the emergency department depends on the competency of the first responder to recognize and promptly treat hypovolemic shock.<sup>[40]</sup> Providing clinical guidelines for nurses as the stone corner of critical care, including children with hypovolemic shock, have been refined as a strategy aimed at detection of early signs of shock, as well as prevention and control of the complications of this major health problem that may cause death in young children.<sup>[15]</sup> Therefore, the current study was aimed to investigate the impact of training program based on clinical guidelines about management of children in hypovolemic shock on nurses' knowledge and performance. This aim is attained through the following objectives:

- Assess nurses' knowledge and their performance regarding management of children suffering from hypovolemic shock (pre-test).
- Design and implement training program based on clinical guidelines regarding management of children in or at risk for developing hypovolemic shock.
- Evaluate the effectiveness the study training program on nurses' knowledge and performance (immediate post-test).
- Evaluate the impact of implementing the guidelines for management of children in hypovolemic shock on the clinical outcome measures of pediatric patients of post-intervention group compared with patients of pre-intervention or usual care group.

### **Research Hypothesis**

**H1:** Implementation of clinical guidelines will significantly improve the nurses' post total knowledge score regarding care of children in hypovolemic shock.

**H2:** Implementation of clinical guidelines will significantly improve the nurses' post practices score regarding care of children in hypovolemic shock.

**H3:** Hypovolemic shock children who received care from competent nurses post implementation of the study training program will get better clinical outcome measures compared with patients who received usual care in the study pre-intervention phase.

## **II. Subjects and Methods**

**2.1 Design:** A quasi-experimental design (pre- and post- test) was utilized in this study.

**2.2. Setting:** This study was conducted at Pediatric Emergency and Medical Departments/Pediatric Children's Hospital affiliated to Ain Shams University Hospitals, Egypt.

**2.3 Subjects:** A convenience sample of 60 bedside nurses was recruited. Twenty nurses from the Pediatric Emergency department and 40 nurses from the Pediatric Medical department, including 8 interns' students who were available during the period of data collection and willing to participate in the study. Both genders were involved regardless their qualifications and years of experience. The study sample involved also 60 children who were admitted in the previously mentioned settings throughout the period of data collection and diagnosed according to the clinical dehydration score as having no, mild, moderate or severe fluid deficit. Those children

were randomly divided into two equal groups; pre- intervention or usual care group (n=30), and post-intervention group (n=30). Children were excluded if they were suffering from chronic illnesses and/or handicaps.

**2.4 Tools of data collection:** Four tools were used to collect the required data. The tools were designed and written in simple Arabic language and consisted of:

**2.4.1 Tool 1. An Assessment sheet for the studied children:** to gather information about their characteristics as gender, age, and ranking, and their medical data including; the cause of hypovolemic shock, the clinical dehydration assessment score and the dehydration treatment procedure.

**2.4.2 Tool 2. An interview questionnaire sheet for nurses:** to assess their knowledge regarding management of children in hypovolemic shock; pre- and post-implementation of the study training program. This tool was developed by the researchers in the light of relevant recent literature and composed of the following parts: The **First part** involved the characteristics of the studied nurses such as age, level of education, years of experience and attendance of a previous training about care of hypovolemic shock. The **Second part** was concerned with the nurses' knowledge (pre/ post training guideline) regarding: definition of hypovolemic shock in children, incidence, causes, signs and symptoms, diagnosis, degrees, types, complications, nursing care plan, and treatment.

#### **Scoring system**

Items of nurses' knowledge assessment about pediatric hypovolemic shock were consisted of 60 closed ended questions. The total score was (100), that distributed according to the importance of each item (20 items were evaluated from 1 and 40 items were evaluated from 2). According to nurse's responses, their knowledge scores were classified into satisfactory ( $\geq 80\%$ ) and unsatisfactory ( $<80\%$ ).

#### **Content validity**

The questionnaire sheet was assessed and ascertained by a panel of five experts in pediatric nursing field to validate its format, layout, consistency, accuracy and relevance.

**2.4.3 Tool 3. Observation checklists:** They were used to assess nurses' practices regarding management of children in hypovolemic shock through direct observation (pre/ post-training guidelines) as follows:

**2.4.3.1 Weight measurement checklists:** it was adopted from the World Health Organization<sup>[16]</sup> and translated into Arabic language by the researchers, included infant's weight checklist that is composed of 13 steps and used if the child is less than 2 years old or is unable to stand, and child's weight checklist that contained 7 steps, and used for the 2 years or older children. Each step was checked as either done correctly (2 scores) or incorrectly done (1 score) or not done (zero). The total scores were 26 or 14 according to the child's age, then the total practice in weighing was scored competent ( $\geq 85\%$ ) or incompetent ( $<85\%$ ).

**2.4.3.2 Temperature measurement checklist:** it was adopted from Devrim and colleagues<sup>[17]</sup>, consisted of 10 steps, which were checked by the researchers as either done correctly (2 scores) or incorrectly done (1 score) or not done (zero). The total score was 20, then the total nurse's practice in temperature measurement was scored competent ( $\geq 85\%$ ) or incompetent ( $<85\%$ ).

**2.4.3.3 Insertion of nasogastric tube checklist:** it was adopted from Irving and colleagues<sup>[18]</sup>, composed of 23 steps related to insertion and confirmation of placement of nasogastric and oro-gastric tubes as well as pediatric patient rehydration through the inserted tube. Each item was checked as either done correctly (2 scores) or incorrectly done (1 score) or not done (zero). The total score was 46, then the total nurse's practice in nasogastric tube checklist was scored competent ( $\geq 85\%$ ) or incompetent ( $<85\%$ ).

**2.4.3.4 Fluid resuscitation skill competency checklist:** it was designed and published by Cinahl Information Systems, a division of EBSCO Information Services<sup>[19]</sup>, illustrated 4 competency areas to replenish intravascular fluid volume of children in or at risk for hypovolemic shock. The first area was related to prerequisite skills, composed of 7 items that were related to nurses' understanding of fluid resuscitation aim and route of administration, as well as the causes of hypovolemic shock in children, risks of exposure to hypovolemic shock, volume of lost intravascular fluid becomes sufficient to cause hypovolemic shock, correct identification of signs and symptoms of hypovolemic shock, and nurses' familiarity with different types of intravenous solutions used during fluid resuscitation. The second area was concerned with preparation before fluids administration, which consisted of 7 items revolved about nurse's review of fluid resuscitation unit protocol, the treating clinicians order, review the manufacture instructions for all medical supplies to be used, in addition to the general consent

for treatment, and review the patient's medical history, and gather the required supplies. The third area was specialized for the procedure of resuscitation fluid and/or bolus of packed red blood cells administration that included 19 steps, started from nurse performed hand hygiene and done personal protective equipment until disposed of used materials in proper receptacles and performed hand hygiene. The last area was concerned with nurse's post-procedural responsibilities, formed of 4 items about the role of the nurse in education and reinforcement about fluid resuscitation, explained the ordered laboratory tests, provided written information if available according to the mother/caregiver level of understanding to reinforce verbal education, and finally documented the care provided in the patient's medical record. Each step/item in the 4 competency areas was checked as either done correctly (2 scores) or incorrectly done (1 score) or not done (zero). The total score was 74, then the total practice of intravenous fluid resuscitation therapy was evaluated competent ( $\geq 85\%$ ) or incompetent ( $< 85\%$ ).

**2.4.4 Tool 4. The training guideline protocol for nurses about care of children suffering from hypovolemic shock:** it was developed by the researchers and prepared in the light of actual needs' assessment of the studied nurses and intern nurses who provided care for children in hypovolemic shock or are at risk for hypovolemic shock. The training guideline was developed in the form of standards of care that based on evidences in the light of different national and international references and was written in simple Arabic language. The guideline was distributed in the form of booklets to both the nurses and parents of children.

## **2.5 Methods**

### **2.5.1 Preparatory phase**

- An approval was obtained from the Scientific Research Ethical Committee in Faculty of Nursing, Ain Shams University before the study has started.
- An official permission to conduct the study was obtained from the medical and nursing director of Emergency Department at Pediatric Hospital affiliated to Ain Shams University Hospitals, and then the researchers met the hospitals' director as well as nursing director and explained the purpose and the methods of data collection and obtained their approval to conduct the study.
- A pilot study required three days and it was carried out on six nurses who represented 10% of the studied subjects at the previously mentioned settings in order to test the applicability of the constructed tools and the clarity of the included questions related to nurses' performance regarding care of hypovolemic shock in children. The pilot study had also served to estimate the time needed for the illustrative session that conducted by the researchers and for each nurse to fill in the questionnaire sheet and answer the study related questions. According to the results of the pilot, no modifications were required. The participants of pilot study were included in the study total sample.
- Ethical consideration was followed through:
  - An oral approval was obtained from each participant nurse before the study beginning, after explanation of the purpose of the study.
  - Oral consents were obtained from the children's caregivers to gain their approval about the participation of their pediatric patients.
  - The researcher assured maintaining anonymity and confidentiality of the collected data throughout the study phases.
  - The participants were informed that they have the right to withdraw from the study at any time without any responsibility.
  - Nurses and children's caregivers were assured that information that is collected would be used only for the purpose of the research.

### **2.5.2 Fieldwork**

The period of data collection was extended over a period of 6 months, started from February 1<sup>st</sup> to the end of July 2018. The researcher was available in the study setting during morning shift 4 days/week (Saturday to Tuesday) to assess nurses' knowledge and their actual performance regarding care of hypovolemic shock children through the following phases:

**Assessment phase (pre-implementation of the training guideline):** It was started with nurses' meeting. At the beginning of the interview, the researchers introduced themselves to the participants' nurses and presented a brief explanation about the aim and nature of the study as well as about the content of the clinical guideline clarified that, it was designed to provide proper care for children in hypovolemic shock. All nurses/interns' students accepted to participate in the study. Each participant interviewed individually, her knowledge about hypovolemic shock in children was assessed using the study tool 2 (questionnaire sheet). Furthermore, while the participant was providing care for the hypovolemic shocked children, her practical skills were directly observed by the researcher using tool 3 (observational checklists) pre-and post-training guideline.

The researcher took 45-60 minutes to fill each questionnaire sheet. Time consumed for assessing the procedures for every nurse took nearly 60-90 minutes. Then, nurses were divided into small groups; each group was composed of 6 nurses and interns' students.

The child's assessment sheet included their characteristics and the child's medical data was filled by the researcher either through parents'/caregiver's interview or through revising the child's medical file if the interview was not possible. To assess the clinical condition of the pediatric patients, the 4 point dehydration assessment tool that composed of; ill-appearance, absent tears, dry mucous membranes, and capillary refill > 2 seconds was applied on admission, in which each item is rated from one score and the total score is 4<sup>[37]</sup>. Based on the assessment score, children with dehydration in both the pre-intervention or usual care group and in the study or post-intervention group were classified into severity subgroups according to fluid deficit percentage into no/mild dehydration, moderate dehydration or severe dehydration when obtained a score of zero/1, 2 or 3-4 respectively. The assessment sheet fulfillment was completed within 10-15 minutes.

**Implementation phase:** The training guideline intervention was implemented at the previously mentioned study settings for 5 weeks, four days per week, and 4-5 hours/day. The study training program conducted on 4 sessions; 2 didactic and 2 practical that covered in 8-10 hours over 2 days of researchers' attendance for each group (6 nurses). The theoretical part was carried out in 5 lectures; the duration of each one was ranged from 45-60 minutes including time of discussion. The theoretical 2 sessions were prepared to cover the following items: definition of hypovolemic shock in children, its incidence, causes, signs and symptoms, diagnosis, nursing assessment, classification, complications, nursing care plan, and treatment. The practical part was provided over 5 hours for 5 practical lessons, the duration of each lesson was 60 minutes including time of discussion. Weighing of an infant or child, measurement of axillary temperature, preparation and administration of medication, nasogastric/oro-gastric tube insertion and administration of Oral Rehydration Therapy (ORT)/formula feeding, and intravenous fluid resuscitation therapy were demonstrated during the time specified for the practical 2 sessions. At the beginning of the first theoretical session, an introduction about the objectives of the training program was given, each lesson started with summary, and feedback of the participants' nurses about previous one. Different methods of teaching were used as: lectures, case scenarios, demonstration and re-demonstration. The training sessions were guided by the material of the clinical guideline protocol prepared by the researchers. Suitable teaching aids were prepared and used during the implementation of the study training on guidelines such as data show, real equipment (for demonstration and demonstration), posters and pictures.

**Evaluation phase**

Nurses were evaluated pre-training implementation to get a baseline assessment prior to the development of the study training program on guideline and immediately post-training implementation by using the same tools 2 and 3 (the questionnaire format sheets and the observation checklists). A comparison between nurses' pre and immediate post-test findings was done to determine the effect of the study intervention on nurses' knowledge and their performance about care of children in hypovolemic shock. Moreover, the clinical outcome measures of pediatric patients were evaluated to see the impact of implementing the study guidelines about management of children in hypovolemic shock, comparing between children of post-intervention group with those of pre-intervention or usual care group.

**2.6 Statistical analysis**

Data collected from the studied sample (nurses and children) were organized, revised, coded and entered using personalized computer (PC). Statistical analysis was fulfilled for computerized data by using the Statistical Package for Social Sciences (SPSS) version 20. Data were presented by using descriptive statistics in the form of frequencies, percentages. Chi-square test ( $\chi^2$ ) was used for comparisons between qualitative variables. Statistical significant was considered at p-value <0.05.

**III. Results**

Table (1) presents the characteristics of the studied nurses, in which 45.0% of the participants were lie in the age group of less than 25 years old (average age, 26.38), as well as 46.7%, and 50.0% of them were had diploma in nursing, and had less than 5 years of experience in nursing profession (average 6.13 years) respectively.

**Table (1):** Percentage distribution of the studied nurses according to their characteristics (n= 60)

Item	No.	%
<b>Age/ years</b>		
<25	27	<b>45.0</b>
25<30	18	30.0
30<35	10	16.7
≥35	5	8.3
<b>Mean ±SD</b>		<b>26.38±6.05</b>

Level of Education		
Nursing Diploma	28	46.7
Diploma with Specialty	9	15.0
Technical Nursing Institute	6	10.0
BSN	15	25.0
Post graduate	2	3.3
Years of Experience		
<5	30	50.0
5<10	14	23.3
10<15	11	18.3
≥15	5	8.3
<b>Mean ±SD</b>	<b>6.13±5.86</b>	

Figure (1) shows that 82.7% of the studied nurses did not previously attend on-the-job training programs about management of children in hypovolemic shock.

**Figure (1):**Percentage distribution of the studied nurses according to attendance of previous training programs about pediatric hypovolemic shock

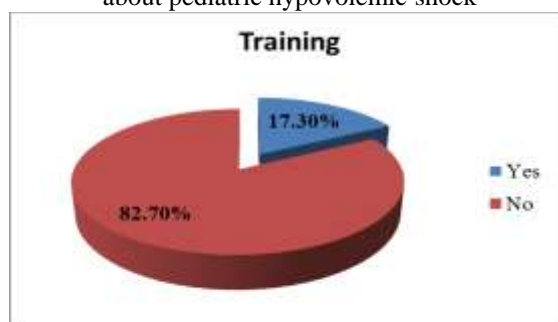


Table (2) proves that there was a marked improvement in the nurses' total knowledge score immediately after implementation of the study training program on guidelines with a statistically significant difference detected ( $p < 0.001$ ).

**Table (2):** Distribution of the studied nurses according to their total knowledge score regarding hypovolemic shock management in children pre- and post-implementation of the training guidelines (n=60)

Nurses' total knowledge score	Pre-program implementation		Post-program implementation		Significance test
	No.	%	No.	%	
Insufficient	50	83.3	7	11.7	$X^2 = 16.101$ $p < 0.001$
Sufficient	10	16.7	53	88.3	

Table (3) illustrates that there was a marked improvement in the nurses' total practices regarding management of children in hypovolemic shock pre- and post-implementation of the training guidelines. A statistically significant difference was detected ( $p < 0.001$ ), because 86.7% of the participants' nurses demonstrated all procedures (practical skills) competently immediately post-implementation of the training on guideline compared to only 20.0% pre- implementation of the training guideline.

**Table (3):** Distribution of the studied nurses according to their total practicescore regarding hypovolemic shock management in children pre- and post-implementation of the training guidelines (n=60)

Nurses' total practice score	Pre-program implementation		Post-program implementation		Significance test
	No.	%	No.	%	
Incompetent	48	80.0	8	13.3	$X^2 = 21.043$ $P = 0.000$
Competent	12	20.0	52	86.7	

Table (4) reveals that there were statistically significant differences between nurses' total knowledge score and their level of education, years of experience in nursing profession, and previous attendance of training programs about care of children in hypovolemic shock pre- ( $p = 0.048, 0.009, \text{ and } 0.037$  respectively) compared to ( $p = 0.044, 0.020 \text{ and } 0.015$  respectively) post-implementation of the training program on guideline.

**Table (4):** Relation between characteristics of the studied nurses and their total knowledge score regarding care of hypovolemic shock pre- and post-implementation of the training guidelines (n=60)

Total Knowledge
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Relation Between Characteristics of the Studied Nurses and their Total Knowledge		Pre-program implementation		Pre-program implementation	
		Insufficient	Sufficient	Insufficient	Sufficient
		%	%	%	%
Age/year	<25	0.0	7.7	40.0	0.0
	25<30	741.2	30.8	60.0	32.0
	30<35	5.9	0.0	0.0	28.0
	≥35	52.9	61.5	0.0	40.0
<b>X<sup>2</sup></b>		2.386		14.291	
<b>p-value</b>		<b>0.496</b>		<b>0.003*</b>	
Education level	Nursing Diploma	58.8	23.1	20.0	20.0
	Diploma with Specialty	11.8	7.7	0.0	48.0
	Technical Nursing Institute	11.8	46.2	40.0	12.0
	BSN	0.0	15.4	20.0	0.0
	Post graduate	17.6	7.7	20.0	20.0
<b>X<sup>2</sup></b>		8.724		9.36	
<b>p-value</b>		<b>0.048*</b>		<b>0.044*</b>	
Years of experience	< 5	41.2	0.0	100.0	32.0
	5 < 10	29.4	15.4	0.0	40.0
	10 < 15	17.6	23.1	0.0	28.0
	> 20	11.8	61.5	0.0	0.0
<b>X<sup>2</sup></b>		11.558		7.846	
<b>p-value</b>		<b>0.009*</b>		<b>0.020*</b>	
Attended a previous training program	Yes	58.8	23.1	80.0	24.0
	No	41.2	76.9	20.0	76.0
<b>X<sup>2</sup></b>		3.975		5.88	
<b>p-value</b>		<b>0.037*</b>		<b>0.015*</b>	

Table (5) shows that there were statistically significant differences between nurses' total practices score and their years of experience working as a professional nurse and previous attending of training programs about care of children in hypovolemic shock at p= 0.002 and 0.013 respectively.

**Table (5):** Relation between characteristics of the studied nurses and their total practices regarding care of hypovolemic shock pre- and post-implementation of the training guidelines (n=60)

Relation Between Characteristics of the Studied Nurses and their Total Practices		Total Practices			
		Pre		Post	
		Incompetent	Competent	Incompetent	Competent
		%	%	%	%
Age/year	<25	0.0	16.7	16.7	4.2
	25<30	41.7	16.7	50.0	33.3
	30<35	4.2	0.0	33.3	20.8
	≥35	54.2	66.7	0.0	41.7
<b>X<sup>2</sup></b>		4.31			
<b>p-value</b>		0.230			
Education level	Nursing Diploma	45.8	33.3	0.0	25.0
	Diploma with Specialty	4.2	33.3	66.7	33.3
	Technical Nursing Institute	29.2	16.7	0.0	20.8
	BSN	4.2	16.7	16.7	0.0
	Post graduate	16.7	0.0	16.7	20.8
<b>X<sup>2</sup></b>		8.125			
<b>p-value</b>		0.067			
Years of experience	< 5	45.8	0.0	66.7	37.5
	5 < 10	33.3	16.7	33.3	33.3
	10 < 15	12.5	33.3	0.0	29.2
	> 20	8.3	50.0	0.0	0.0
<b>X<sup>2</sup></b>		12.924			
<b>p-value</b>		<b>0.002*</b>			

Attended previous Training program	Yes.	66.7	16.7	33.3	83.3
	No.	33.3	83.3	66.7	16.7
$\chi^2$		6.136			
p-value		<b>0.013*</b>			

Table (6) shows that there was a significant positive association between nurses' knowledge and practice regarding hypovolemic shock management in children pre- and post-implementation of the training on guidelines, with highly statistical significant differences found at  $p=0.013$  and  $p<0.001$  respectively.

**Table (6):** Association between nurses' knowledge and practice regarding hypovolemic shock management in children pre- and post-implementation of the training guideline (n=60)

Variables	Knowledge pre-program implementation		Knowledge post-program implementation	
	r	P	r	P
Practice pre-program implementation	<b>0.271</b>	<b>0.013*</b>		
Practice post-program implementation			<b>0.383</b>	<b>&lt;0.001*</b>

As noticed in table (7), 56.7% of the studied children in the post-intervention group and 50% in the pre-intervention group were boys and the largest percentages (56.7% & 53.35) of the post-intervention group compared with 46.7% and 60.0% in the usual care group were younger than 3 years old and were the first children for their parents respectively, with a statistical significant difference detected between the two groups regarding children birth order at  $p=0.01$ . This table also showed that the major cause of hypovolemic shock among about four fifths of pediatric patients in both the pre- and post-intervention groups were related to diarrhea with or without vomiting.

In the post-study intervention group, 14 patients (46.7%) were mildly, 6 (20.0%) moderately and 10 (33.3%) severely dehydrated children, compared with 16 (53.3%), 11 (36.7%) and 3 (10%) in the pre-study intervention group. About one half of the studied children in both two groups received oral rehydration therapy (ORT) via mouth and 30% of patients in the post-intervention group received intravenous (IV) rehydration therapy compared with 16.7% of patients in the usual care group. There were significant differences in the clinical overall dehydration score and in dehydration mode of treatment between the post-intervention group and the usual care group ( $p=0.02$  &  $p=0.01$  respectively).

**Table (7):** Distribution of the studied children according to their characteristics and medical data (n=60)

Variables	Post intervention group (n=30)		Pre intervention = usual care group (n=30)		p-value
	No.	%	No.	%	
<b>Gender</b>					NS
Boy	17	<b>56.7</b>	15	50.0	
Girl	13	43.3	15	<b>50.0</b>	
<b>Age in years</b>					NS
< 3	17	<b>56.7</b>	14	<b>46.7</b>	
3 ≤ 6	11	36.6	12	40.0	
6 ≤ 9	2	6.7	4	12.3	
<b>Mean ± SD</b>	<b>3.29±1.91</b>		<b>3.71±2.03</b>		
<b>Birth order</b>					<b>0.01*</b>
First	16	<b>53.3</b>	18	<b>60.0</b>	
Second	8	26.7	9	30.0	
Third	6	20.0	3	10.0	
<b>Cause of hypovolemic shock</b>					NS
- Prolonged fever	3	10.0	5	16.7	
- Diarrhea ± vomiting	25	<b>83.3</b>	24	<b>80.0</b>	
- Burns	2	6.7	1	3.3	
<b>Clinical dehydration assessment score (fluid deficit)</b>					<b>0.02*</b>
- No/Mild (<5%)	14	<b>46.7</b>	16	<b>53.3</b>	
- Moderate (5 - 9%)	6	20.0	11	36.7	
- Severe (≥10%)	10	33.3	3	10.0	
<b>Dehydration treatment procedure</b>					<b>0.01*</b>
- ORT via the mouth	13	<b>43.3</b>	15	<b>50.0</b>	
- ORT via the nasogastric tube	8	26.7	10	33.3	
- IV rehydration therapy	9	30.0	5	16.7	



Apparently, table (8) illustrated that children in hypovolemic shock who admitted immediately after implementation of the training program based on guidelines showed a significant improvement in their clinical outcome measures; as they gained more weight on time of discharge (mean 42.64 gm), stayed less time in the hospital (mean 16.54 hours) and showed less case fatality (one patient) compared with 24.20 gm, 20.88 hours and 3 patients respectively among the pre-intervention group who admitted before implementation of the study training program and received usual care. There were statistically significant differences between the study two groups regarding discharge weight, length of hospital stay and mortality rate at  $p=0.001$ ,  $p<0.001$  and  $p=0.04$  respectively.

**Table (8)** Distribution of pediatric patients' according to their clinical outcome measures pre- and post-implementation of the training program (n=60)

Variables	Post-intervention group (n=30)	Pre-intervention usual care group (n=30)	=	p-value
- Weight gain on discharge, mean $\pm$ SD, gms	42.64 $\pm$ 1.12	24.20 $\pm$ 4.04		0.001*
- Length of hospital stay, mean $\pm$ SD, hrs	16.54 $\pm$ 12.58	20.88 $\pm$ 16.21		<0.001*
- Mortality rate, n (%)	1/30 (0.033)	3/30 (0.099)		0.04*

#### IV. Discussion

Shock accounts for 2% of children admitted to pediatric casualty worldwide. It has a high case fatality in hospitals within low-income countries<sup>[7,8]</sup>. Shock is defined as a state of acute energy failure due to inadequate glucose substrate delivery, oxygen delivery, or mitochondrial failure at the cellular level. The clinical state of shock is diagnosed on the basis of vital signs, physical examination, and laboratory data, although its recognition in the pediatric patient can be difficult<sup>[20]</sup>.

As regards the characteristics of the participants' nurses, the current study clarified that less than half of the studied nurses were in the age group < 25 years, and were graduated from secondary school of nursing, while about one half had < 5 years' experience in nursing profession (table 1). These findings were different from that of Ibrahim 2017,<sup>[21]</sup> who conducted a study about Nurses knowledge Regarding Nursing Care of Children with Dehydration in Khartoum State, Sudan and found that, more than half of nurses' age was between 30-35 years old, more than four fifths of nurses had bachelor degree in nursing, and more than two thirds had 2-5 years of experience. Similar to what were reported by Stephens and colleagues 2017,<sup>[22]</sup> in their study about Capacity building for critical care training delivery: Development and evaluation of the Network for Improving Critical Care Skills Training (NICST) programme in Sri Lanka, and Chang and colleagues 2015,<sup>[23]</sup> in a study entitled Perceptions and experiences of nurse preceptors regarding their training courses: A mixed method study, the current study revealed that more than three quarters of the studied nurses did not attend training programs about pediatric shock (Fig. 1).

The present study findings portrayed that, more than four fifths of the studied nurses had insufficient didactic information about hypovolemic shock in children pre-implementation of the study intervention which significantly improved immediately post implementation of the study training program on guidelines (table 2). This result is in an agreement with a recent study by Huffer 2017,<sup>[24]</sup> aimed at Improving New Graduate Critical Care Nurse Practitioner Knowledge and Retention Using a Dedicated Orientation and Mentoring Program and concluded that, nurses' knowledge about definition, and causes of pediatric shock, and predisposing factors of hypovolemic shock, and degrees, signs, of dehydration and pre-shock warning signs, as well as nursing assessment and management of hypovolemic shock were improved significantly after program implementation. Moreover, similar findings were also presented in two studies conducted by Amin and Musa 2013,<sup>[25]</sup> and Chandrasekaran and colleagues 2017,<sup>[26]</sup> who found that the majority of nurses had very good knowledge about degrees of shock, its warning signs and management post-implementation of the study training program. The current study collective findings were also supported by Anim-Larbi 2017,<sup>[27]</sup> who studied knowledge of nurses in management of diarrhea for under-five years' children, and found that the majority of the nurses had a good knowledge about shock related dehydration diagnosis and its prevention post-implementation of the study training program.

Regarding points of distinction in infant and child weighing technique, it was clarified that a high percentage of nurses were incompetent in their measurement practices pre-implementation of the study training intervention, then these practices showed a significant improvement immediately post-implementation of the study training on guideline (table 3). This may be attributed to lack of nurses' interest, as well as lack of their awareness about the importance of accurate body weight measurement for pediatric patients' assessment and decision making. These findings were got along with those studies done by Pruvost and colleagues 2013,<sup>[28]</sup> Key 2015,<sup>[29]</sup> and Numminen and colleagues 2015,<sup>[30]</sup> who studied the value of precise body weight measurement to

assess dehydration in children, and mentioned that the indicator most commonly used to estimate children status is acute weight loss.

On assessing nurses' practical skills concerning care provided to children in hypovolemic shock, including the steps of nasogastric tube insertion, fluid resuscitation, and preparation and administration of intravenous medication; specially checking patient's rights of safe medication administration, patency of intravenous peripheral or central catheter, the role of the nurse during intravenous fluids administration, and placing the solution content label on intravenous bag, the present study illustrated that the majority of nurses' practices were incompetent pre-implementation of nurses' training on guideline, compared with an improvement that was observed immediately post-implementation of the study guidelines (table 3). These findings were similar to those of a study done by Ridling and colleagues (2016),<sup>[31]</sup> who mentioned that most of the nurses had good skills about calculation and administering medication post implementation of the study training protocol.

The current study found a positive relation between the studied nurses' level of education and their total knowledge score (table 4), as well as a significant link between nurses' years of experience, and previous attendance of training programs about pediatric shock and their total knowledge and total practice scores about hypovolemic shock in children, pre- and post-implementation of nurses' training program on guidelines (table 4 & 5). This result was supported by Bayoumi, and Mahmoud 2017,<sup>[32]</sup> who conducted a study about the effect of education program on nurses' knowledge and practice regarding care of central venous line in pediatric hemodialysis: evidence-based practice, and O'Leary and colleagues 2016,<sup>[33]</sup> who found that there were significant relationships between nurses' level of knowledge and practices and their education level, workplace experience years, and previous attendance of training programs.

Additionally, the current study reported that there was a significant positive correlation between nurses' knowledge and practice pre- and immediately after implementation of the study training program (table 6). This finding was supported with Carson and colleagues 2017,<sup>[34]</sup> who carried out a study about Evaluation of a Nurse-Initiated Acute Gastroenteritis Pathway in the Pediatric Emergency Department and found a highly statistically significant association between nurses' knowledge and their practice in pre- and post-program implementation phases. From the researchers' point of view, this finding proven that high level of nurses' scores of knowledge is usually associated with increased level of competent clinical performance.

The medical data obtained from pediatric patients' present health history showed in table (7) revealed that the causes of hypovolemia induced shock were related to diarrhea with or without vomiting, prolonged fever and burns. A doctoral dissertation conducted by Ibrahim 2017,<sup>[21]</sup> also found that, hypovolemic shock among infants and children generally results from diarrhea, vomiting, poor fluid intake, hemorrhage, heat stroke/fever for a long period or burns. Furthermore, two recent studies by Geurts and colleagues 2017,<sup>[35]</sup> and Kotloff 2017,<sup>[36]</sup> are in accordance with the current study findings and mentioned that the major cause of pediatric hypovolemic shock is diarrhea and vomiting. Add to that, the treatment considerations vary based on health care resources and classification of dehydration into severity subgroups (no, mild, moderate, severe) by percent of weight lost during the illness if it is known or by clinical dehydration assessment score. In their study about Evaluation and Management of Dehydration in Children, Santillanes, and Rose 2018,<sup>[38]</sup> reported that dehydration may be treated with oral, subcutaneous, or intravenous fluids and most children with mild to moderate dehydration can be successfully rehydrated with oral rehydration. These go in the same line with what was presented in the current study (table 7) regarding dehydration treatment, in which a significant difference ( $p=0.01$ ) was recorded between the study two groups as for the treatment procedure that may be related to the effect of applying the study training program induced proper nursing assessment and subsequently correct prescription of medical treatment to correct fluid deficit volume of children of post-intervention group.

The current study showed an upswing among the clinical outcome measures of hypovolemic shock children who received care from competent nurses post-implementation of the study training program compared with their peers who received usual care by attending nurses in the study pre-intervention phase. This finding is supported by Geurts and colleagues 2017,<sup>[39]</sup> who conducted a study about implementation of clinical decision support in young children with acute gastroenteritis aimed to evaluate the impact of a nurse-guided clinical decision support system for rehydration treatment in children with acute gastroenteritis, proved a significant improvement in length of stay (LOS) at the emergency department, the number of diagnostic tests, treatment, follow-up, and costs of children in the study group compared with usual care group. However their study found no weight difference among dehydrated children of both groups which is contradicted with the existing study findings (table 8).

## **V. Limitation of the study**

1- The study two settings (emergency and medical departments) were too noisy, overcrowded and lacking privacy; therefore, there was some difficulty to carry out an interview with the study subjects (nurses, and pediatric patients and their caregivers).

2- Nurses' work overload interferes with easy completion of the assessment questionnaire sheet, and observational checklists which need more effort and long time to complete the study assessment tools.

## VI. Conclusion

Based on the findings of the current study, it is concluded that, nurses' knowledge and practice were significantly improved after implementation of training clinical guidelines about management of children in hypovolemic shock. As a result, the study training program on guidelines is effective to be applied in pediatric emergency care settings receiving patients suffering from or at risk for hypovolemic shock.

## VII. Recommendations

- The study emphasizes the importance of periodically applying on-job-training programs for nurses about management of hypovolemic shock in children.
- Clinical protocols of nursing care regarding hypovolemic shock should be followed to improve nursing management as well as pediatric patients' clinical outcomes.
- Further studies with larger number of participants' nurses to assess and improve their performance concerning management of children in hypovolemic shock is required for generalization of the study findings.

## Author Disclosure Statement

No competing financial interests and/or associations that pose real or perceived conflicts of interest in connection with the article exist.

## References

- [1]. Schwartz, D. A., & Holcomb, J. B. (2013). The careful art of resuscitation. In *Common Problems in Acute Care Surgery* (pp. 3-17). Springer, New York, NY.
- [2]. Schwartz, D. A., & Holcomb, J. (2017). Initial resuscitation and management of the hemodynamically unstable patient. In *Common Problems in Acute Care Surgery* (pp. 3-15). Springer, Cham.
- [3]. Ponsky, T. A., & Garrison, A. P. (2016). *Emergency Pediatric Surgery, An Issue of Surgical Clinics, E-Book* (Vol. 97, No. 1). Elsevier Health Sciences.
- [4]. Endom, E. E., Somers, M. E., Mattoo, T. K., & Kim, M. S. (2011). Clinical assessment and diagnosis of hypovolemia (dehydration) in children.
- [5]. Hobson, M. J., & Chima, R. S. (2013). Pediatric hypovolemic shock. *Open Pediatr Med J*, 7(Suppl. 1: M3), 10-15.
- [6]. Cannon, J. W. (2018). Hemorrhagic shock. *New England Journal of Medicine*, 378(4), 370-379.
- [7]. Gobinathan, S., & Kannan, K. S. (2018). Study of prevalence, etiology, response to treatment and outcome of paediatric shock in a tertiary care hospital. *International Journal of Contemporary Pediatrics*, 5(3), 1104-1108.
- [8]. Mbevi, G., Ayieko, P., Irimu, G., Akech, S., & English, M. (2016). Prevalence, aetiology, treatment and outcomes of shock in children admitted to Kenyan hospitals. *BMC medicine*, 14(1), 184.
- [9]. Santillanes, G., & Rose, E. (2018). Evaluation and Management of Dehydration in Children. *Emergency medicine clinics of North America*.
- [10]. El Mehrat, A. M., Ghareeb, F. M., Keshk, T. F., El Sheikh, Y. M., & Ibrahim, A. H. (2014). Retrospective study of mortality and causes of death in Menofia University Burn Center. *Menoufia Medical Journal*, 27(2), 290.
- [11]. Retezar, R., Bessman, E., Ding, R., Zeger, S. L., & McCarthy, M. L. (2011). The effect of triage diagnostic standing orders on emergency department treatment time. *Annals of emergency medicine*, 57(2), 89-99.
- [12]. Abdel-Aziz, S. B., Mowafy, M. A., & Galal, Y. S. (2016). Assessing the impact of a community-based health and nutrition education on the management of diarrhea in an urban district, Cairo, Egypt. *Global journal of health science*, 8(2), 46.
- [13]. Møller, M. H., Claudius, C., Juntila, E., Haney, M., Oscarsson-Tibblin, A., Haavind, A., & Perner, A. (2016). Scandinavian SSAI clinical practice guideline on choice of first-line vasopressor for patients with acute circulatory failure. *Acta Anaesthesiologica Scandinavica*, 60(10), 1347-1366.
- [14]. Yost, J., Ganann, R., Thompson, D., Aloweni, F., Newman, K., Hazzan, A., ... & Ciliska, D. (2015). The effectiveness of knowledge translation interventions for promoting evidence-informed decision-making among nurses in tertiary care: a systematic review and meta-analysis. *Implementation Science*, 10(1), 98.
- [15]. Sayed, Y., El-Sayed, A. Z., & El-Fattah, S. A. (2014). Effects of socioeconomic status on infectious diarrhea in Egyptian children. *International Journal of Nutrition and Food Sciences*, 3(6), 519-525.
- [16]. World Health Organization. (2008). Training course on child growth assessment. Geneva: WHO, p17-25.
- [17]. Devrim, I., Kara, A., Ceyhan, M., Tezer, H., Uludag, A.K., Cengiz, A.B., Yigitkanl, I., & Secmeer, G. (2007). Measurement accuracy of fever by tympanic and axillary thermometry. *Pediatric Emergency Care*, 23(1), 16-19.
- [18]. Irving, S. Y., Lyman, B., Northington, L., Bartlett, J. A., & Kemper, C. (2014). Nasogastric tube placement and verification in children: review of the current literature. *Critical care nurse*, 2014606.
- [19]. Cinahl Information Systems, a division of EBSCO Information Services (2017). Assisting with Fluid Resuscitation in children. Retrieved from [https://www.ebscohost.com/assets-sample-content/NRC\\_AssistingWithFluidResuscitationInChildren\\_CL.pdf](https://www.ebscohost.com/assets-sample-content/NRC_AssistingWithFluidResuscitationInChildren_CL.pdf)
- [20]. Crawford, D. (2018). Understanding fluid homeostasis in infants and children: part 2. *Nursing children and young people*, 30(3).
- [21]. Ibrahim, A. E. O. (2017). *Nurses, knowledge Regarding Nursing Care of Children with Dehydration at Gaffer Ibnouf Hospital, Khartoum State, Sudan (2016)* (Doctoral dissertation).

- [22]. Stephens, T., De Silva, A. P., Beane, A., Welch, J., Sigera, C., De Alwis, S., ...&Abeynayaka, A. (2017). Capacity building for critical care training delivery: Development and evaluation of the Network for Improving Critical Care Skills Training (NICST) programme in Sri Lanka. *Intensive and Critical Care Nursing*, 39, 28-36.
- [23]. Chang, C. C., Lin, L. M., Chen, I. H., Kang, C. M., & Chang, W. Y. (2015). Perceptions and experiences of nurse preceptors regarding their training courses: A mixed method study. *Nurse education today*, 35(1), 220-226.
- [24]. Huffer, K. (2017). Improving New Graduate Critical Care Nurse Practitioner Knowledge and Retention Using a Dedicated Orientation and Mentoring Program.
- [25]. Amin, N.M. and Musa, A.O. (2013): Quality of nursing care for under-five children regarding management of dehydration Khartoum city-governmental hospitals, master thesis in pediatric nursing, faculty of nursing sciences - Al Neelain university, and faculty of medicine - international university of Africa - Khartoum, Sudan, Pp, 6-10, available at: [http://repository.neelain.edu.sd:8080/jspui/bitstream/123456789/1407/1/3\\_7.pdf](http://repository.neelain.edu.sd:8080/jspui/bitstream/123456789/1407/1/3_7.pdf). Accessed at: 20 June 2014.
- [26]. Chandrasekaran, A., Anand, G., Ward, P., Sharma, L., & Moffatt-Bruce, S. (2017). Design and Implementation of Standard Work on Care Delivery Performance: A Quasi-Experimental Investigation.
- [27]. Anim-Larbi, M. (2017). Management of Diarrhoeal Diseases in Children Under Five Years by Market Women: The Case of Makola, Accra (Doctoral dissertation, University Of Ghana).
- [28]. Pruvost, I., Dubos, F., Chazard, E., Hue, V., Duhamel, A. and Martinot, A. (2013): The value of body weight measurement to assess dehydration in children. *Plos One*; 8(1): e55063. Published online 2013 Jan 29. doi: 10.1371/journal.pone.0055063.
- [29]. Key, J. (2015). A novel approach to the rehydration of children with gastroenteritis in the emergency department (Doctoral dissertation, Auckland University of Technology).
- [30]. Numminen, O., Leino-Kilpi, H., Isoaho, H., &Meretoja, R. (2015). Newly graduated nurses' competence and individual and organizational factors: A multivariate analysis. *Journal of Nursing Scholarship*, 47(5), 446-457.
- [31]. Ridling, D., Christensen, P., Harder, L. R., Gove, N., & Gore, S. (2016). Pediatric nurse performance on a medication dosage calculation assessment tool. *Journal of pediatric nursing*, 31(2), e133-e140.
- [32]. Bayoumi, M. H., & Mahmoud, N. F. (2017). Effect of education program on nurses' knowledge and practice regarding care of central venous line in pediatric hemodialysis: evidence-based practice guidelines. *Egyptian Nursing Journal*, 14(2), 87.
- [33]. O'Leary, J., Nash, R., & Lewis, P. (2016). Standard instruction versus simulation: Educating registered nurses in the early recognition of patient deterioration in paediatric critical care. *Nurse education today*, 36, 287-292.
- [34]. Carson, R. A., Mudd, S. S., &Madati, P. J. (2017). Evaluation of a Nurse-Initiated Acute Gastroenteritis Pathway in the Pediatric Emergency Department. *Journal of Emergency Nursing*, 43(5), 406-412.
- [35]. Geurts, D., Steyerberg, E. W., Moll, H., &Oostenbrink, R. (2017). How to predict oral rehydration failure in children with gastroenteritis. *Journal of pediatric gastroenterology and nutrition*, 65(5), 503-508.
- [36]. Kotloff, K. L. (2017). The burden and etiology of diarrheal illness in developing countries. *Pediatric Clinics*, 64(4), 799-814.
- [37]. Fleisher, G. R., & Ludwig, S. (Eds.). (2010). *Textbook of pediatric emergency medicine*. Lippincott Williams & Wilkins.
- [38]. Santillanes, G., & Rose, E. (2018). Evaluation and Management of Dehydration in Children. *Emergency medicine clinics of North America*.
- [39]. Geurts, D., de Vos-Kerkhof, E., Polinder, S., Steyerberg, E., van der Lei, J., Moll, H., &Oostenbrink, R. (2017). Implementation of clinical decision support in young children with acute gastroenteritis: a randomized controlled trial at the emergency department. *European journal of pediatrics*, 176(2), 173-181.
- [40]. Sawaya RD, Ravandi B. Fluids and Electrolyte Management. AHC; (2016). Available from: <https://www.ahcmedia.com/articles/137306-fluids-and-electrolyte-management-part--fluids-dehydration-and-sodium-homeostasis>

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