

## Tracheostomy Care Bundle: its Effect on Nurses' Performance and Patients' Health Outcomes

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### Abstract:

**Context:** Patients with a tracheostomy are considered to be high risk for some complications and have numerous complexities for nurses to consider. **Aim:** To evaluate how tracheostomy care bundle can affect nurses' performance and patient' health outcomes. **Methods:** The study employed a **quasi-experimental research design**. The study was conducted in Benha University Hospital at intensive care unit on a **convenience sample** of 70 nurses and 36 tracheostomy patients using **three tools:** Self-administered questionnaire, St Mary's Tracheostomy Care Bundle Observational Checklist and Patient' Health Outcomes sheet. **Results:** Showed that total knowledge score of studied nurses was poor at pretest phase 71.4%. While being improved into good at immediate posttest 95.7% and follow up phase 87.1%. In addition, total practice score of studied nurses was inadequate at pretest phase 81.4%. while it changed to be adequate at immediate posttest 78.6% and at follow up phase 70%. On the same line, more than half of tracheostomy patients experienced low clinical risk and complications after care bundle implementation with high statistically significant differences between pre and post bundle implementation observed as  $p < 0.001$ . **Conclusion:** The application of tracheostomy care bundle program for nurses was successful in enhancing patients' outcomes. **Recommendation:** Developing Tracheostomy care bundle booklet or poster should be involved at critical units with optimizing level of nursing training sessions to improve patient' health outcomes and quality of care provided.

**Keywords:** Nurse's Performance, Patient' Health Outcomes, Tracheostomy Care Bundle

### Introduction

Tracheostomy is a surgical procedure done into the anterior wall of the trachea to make an exterior opening or stoma. Tracheostomy tube is inserted at the time of surgery to maintain a patent airway (Skoretz et al., 2020). There are two main techniques of tracheostomy; open surgical tracheostomy performed by surgeons and percutaneous tracheotomy performed by surgeons or anesthetists. Surgical method may be required if percutaneous one is contraindicated due to anatomic or other patient-related problems (Hashimoto et al., 2020).

General indications of tracheostomy include acute respiratory failure with the expected need

for prolonged mechanical ventilation to facilitate the weaning process, upper airway obstruction, edema resulting from inhalation, burns injury, anaphylaxis, copious secretions, trauma or infection (Kennedy et al., 2021). While contraindicated in cases of local infection, coagulopathy, thrombocytopenia, thyroid mass and obesity (Gupta et al., 2020).

The aim of tracheostomy is to bypass obstruction in the upper airway, to aid prolonged and assisted ventilation and to facilitate the removal of respiratory secretions or improve secretion clearance. Additionally, lessened laryngeal or tracheal lesions, reduce risk of sinusitis and shorter requirement of sedatives and analgesic medications, facilitate oral hygiene and care by nursing personnel

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(Whitmore et al., 2020). This reduces the incidence of tube obstruction by inspissated mucus, makes the patient more comfortable with easier communication and reduce the aspiration through improved glottic function (Khaja et al., 2022).

Patients with a tracheostomy are considered to be high risk for some complications and have numerous complexities for nurses to consider. So, all healthcare providers should be well aware of any potential risks and their management particularly in immediate life-threatening situations (Toole, 2021). The complications can be either early or late. The early complications include tube occlusion, infection of the stoma site, aspiration, impaired cough, hemorrhage, airway obstruction or excessive granulation of the trachea. While late complications include tracheal or laryngeal stenosis, compromised breathing, peristomal skin breakdown and pressure ulcers following the removal of a tracheostomy (Nyanzi et al., 2023).

Tracheostomy management is a complex activity with several potential complications as nosocomial infections, extended hospitalization, airway complications and even death if the nurse lacks the essential knowledge and skills to provide appropriate care with poor suctioning technique (Harding et al., 2020). Additionally, unavailability of standard guidelines about tracheostomy management and inadequate health care staff training can make caring for patients much more difficult and complex (Chaikhamming et al., 2023).

Postoperative care is considered the most important way for achieving good patient health outcomes. Health care staff play a vital role in providing post tracheostomy care and management of acute and life-threatening events (Beshay et al., 2020). Therefore, nurses must understand facility tracheostomy care policy and possess specific knowledge and

skills to provide successful care for those patients (Mahfoz, 2022).

Nursing priorities for the tracheostomy patient must be supportive and focus on maintaining and improving respiratory function while preventing complications (Phookan & Talukdar, 2023). Being prepared to provide general tracheostomy care and suctioning and to apply skill during urgent situations are essential for achieving successful patient outcomes. The nurse should provide tracheostomy care and suctioning for this patient without any difficulties (Murray et al., 2022).

Dimensions of Nursing care for tracheostomy patients include; securing tracheostomy tubes in place, keeping the tube free of secretions, maintaining a patent airway, providing wound care, as well as preventing skin breakdown and tube blockage (Pereira et al., 2020). In addition to assessing the area for redness or tenderness, cleaning, replacing, or changing the inner cannula, changing the dressing, providing humidification and oral hygiene, maintaining cuff pressure and suctioning (Nabil et al., 2022).

### **Significant of the study:**

Tracheostomy is an invasive procedure performed in patients who are expected to require prolonged mechanical ventilation or airway management. In the world, about 250 000 tracheostomies were performed annually and in the United States now the average number is more than 100,000 (Zouk & Batra, 2021). Approximately 10–20% of respiratory disease patients who admitted to intensive care units (ICUs) were in need for tracheostomy as a lifesaving surgical procedure (Kishihara, et al., 2023). While the number of tracheostomy patients who admitted to intensive care unit at Benha University Hospital in the year (2022) was about 50 patients (Benha University Hospital Statistical Office, 2022).

Tracheostomy-related complications were displayed in 24% of ICU patients and in 31% of ward patients and the rate of early complications were 37.5% while late complications were 7.5% (Khanum et al., 2022). These complications have a wide spectrum of respiratory abnormalities, associated with increase morbidity and mortality rate, hospitalization time and costs mainly hemorrhage, tube dislodgement and tube obstruction (Quinn et al., 2022) with incidence rate of 10–60% depending on co-morbidities during cannulation and/or after decannulation (Levy et al., 2022). These problems can be minimized through frequent patients' assessment and effective tracheostomy care with considerable attention and management in hospitals to improve the care, safety and outcomes of patients with a tracheostomy (Mc Mahon et al., 2023). Therefore, the current study was designed to evaluate the effect of tracheostomy care bundle on patients' health outcomes.

#### **Aim of the study:**

This study was conducted to evaluate how tracheostomy care bundle can affect nurses' performance and patient' health outcomes.

#### **Study hypotheses:**

**H1.** The mean score of nurses' knowledge after tracheostomy care bundle implementation could be higher than before.

**H2.** The mean score of nurses' practices after tracheostomy care bundle implementation could be higher than before.

**H3.** Patient' health outcomes could be improved after implementation of tracheostomy care bundle than before.

#### **Operational definitions:**

**Nurses' performance:** Refers to nurses' level of knowledge and practice.

**Tracheostomy care bundle:** A set of six evidence-based practices performed collectively and reliably to improve the quality of care provided for tracheostomy patients including: Humidification, suctioning, care of inner cannula, stoma care, cuff pressure management and preparations for emergency situations (Willimams&Edwars,2020).

**Patient' health outcomes:** in this study involves physiological parameters as (respiration, pulse, temperature, blood pressure and oxygen saturation), respiratory distress signs, infection signs (stoma site infectin, respiratory infection), and tube dislodgment or obstruction signs).

**Research Design:** Quasi- experimental design was applied (pre and posttest).

**Setting:** The study carried out in general intensive Care Unit at Benha University Hospital, Qalyubia Governorate, Egypt. It locates in medical building at 2<sup>nd</sup> floor containing 22 beds. Nurse to patient ratio is 1:2

**Subjects:** Convenience sample of nurses who assigned to provide direct care to patients (70 nurses) were recruited in study. in addition, all available tracheostomy patients during period of data collection (36 patients) involved into study.

**Tools of data collection:** Three tools devolped by researchers to collect data within study phases (pretest, immediate post test, follow up) which were:

#### **Tool I- Self-administered questionnaire:**

It designed by the researchers after reviewing recent literature in simple Arabic language (Brendan et al., 2020), (Harding et al., 2020) & (Khanum et al., 2022) consisting of two parts:

**Part I: Socio demographic data of studied nurses** related to age, gender, marital status,

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educational level, years of experiences and training programs attendance.

**Part II: Structured knowledge questionnaire** involving 80 multiple choice questions with four alternative responses to evaluate nurses' knowledge toward tracheostomy care bundle divided into four sections as follows:

**Section A:** anatomy and physiology of trachea (5 questions).

**Section B:** tracheostomy definition, purposes, indication, contraindications, associated early and late complications (10 questions)

**Section C:** types of tracheostomy tubes (4 questions).

**Section D:** tracheostomy care bundle items as humidification, suctioning, inner tube care, stoma care or dressing, tracheal cuff pressure management, and preparation of emergency equipment for critical situations (61 questions).

**Scoring system:** Each correct response was allotted one and incorrect response was allotted zero. The total score of knowledge was 80 points. These scores were summed up and converted into a percent and categorized as:

**Good** at  $\geq 75\%$  (60 points or more).

**average** at  $\geq 50\%$  (40 points or more).

**poor** at  $< 50\%$  (Less than 40 points)

**Tool II: St Mary's Tracheostomy care bundle observational checklist (National Institute for Health and Care Excellence,2020)**

This tool modified by the researchers after reviewing related literature (Blakeley,2020), (Ignatavicius et al.,2021), (Mussa et al., 2021) &(Cobbett,2022) to evaluate nurses' skills toward six evidence-based elements of care bundle using direct observation involving:

1- Humidification including: Oxygen therapy, nebulization and care of ventilated patient via tracheostomy (40 steps).

2- Suctioning (open system): (26 steps).

3- Care of inner cannula (20 steps).

4- Stoma care (22 steps).

5- cuff pressure management including: Cuff pressure measurement, cuff deflation and re-inflation (18 steps).

6- Preparations for emergency situations (4 steps).

**Scoring system:** Each step done correctly was scored one, and zero for incorrectly done & not done, the total practice scores was 130 points. These scores were converted into a percent and categorized as:

**adequate** at  $\geq 80\%$  (104 points or more).

**In adequate**  $< 80\%$  (less than 104 points).

**Tool III: Patient' health outcomes sheet:** It was designed by researchers to assess patient health outcomes before & after care bundle program implementation including:

**Part I: Demographic data** of studied patients as age, gender, comorbid diseases and diagnosis.

**Part II: Physiological parameters** such as respiration, oxygen saturation, blood pressure, pulse rate, temperature and level of consciousness were assessed using **National Early Warning Score (NEWS)**. In which score of 0, 1, 2 or 3 is allocated to each parameter. A higher score means the parameter is further from the normal range (Moore & Cunningham, 2021). Appropriate clinical responses are given for threshold levels

**low risk** (aggregate score 1 to 4)

**medium risk** (aggregate score 5 to 6)

**high risk** (aggregate score of 7 or over).

**Part III: Complications related outcomes:** Each patient with tracheostomy was assessed for presence or absence of the following:

- **infection signs** as skin redness or discoloration, swelling, pain and purulent discharges.
- **tube dislodgment or obstruction signs** as low cuff pressure measurement, inability to pass a suction catheter, noisy breathing, low airway pressure alarms and low expiratory volume.
- **respiratory tract infection signs** as increase in white blood cells count, positive sputum culture for microorganism and increase need for suctioning.
- **respiratory distress signs** as decreased oxygen saturation, cyanosis, increased pulse & respiratory rate, use of accessory muscles, reduced chest movement and stridor.

**Tracheostomy care bundle booklet:** It was developed by the researchers based upon identified nurses' educational needs gathered during pretest phase and designed in a simple Arabic language with colored pictures that involved all theoretical and practical aspects to improve their learning abilities. It contained definition, purposes, indications, contraindications, complications, types of tracheostomy tubes and practical skills related to St Mary's care bundle as humidification, suctioning, inner tube care, stoma care or dressing, tracheal cuff pressure management and preparation of emergency equipment for critical situations.

## **Procedures**

### **Administrative design and ethical consideration**

Approval to conduct the study granted from Scientific Research and Ethics Committee of the Faculty of Nursing at Benha University. Formal agreements were obtained from the head of ICU department at Benha University Hospital and Faculty of Nursing dean. During the study, great attention was given to ethical aspects as all participants were informed about the study's aim, objectives, and right to discontinue participation at any time without giving any reasons was confirmed. Verbal and

written consent obtained from study sample. In addition, confidentiality and anonymity were ensured at all study phases.

**Content validity and reliability:** A jury of five experts from the medical-surgical nursing department, Faculty of Nursing at Benha University undertook the validation process for tools' content. Modifications were done according to expert's evaluation of the content's applicability, comprehensiveness, and sentence clarity. **Cronbach's alpha test** was used to assess reliability of knowledge questionnaire, observational checklist and patient' health outcomes sheet showing values of (0.89, 0.85, 0.82 respectively) indicating good reliability.

**Pilot study:** Ten percent of sample size was used for pilot study including four patients and seven nurses aiming to assess clarity and applicability of the tools, as well as estimation of time required to complete them. Modifications were made based on pilot study' results. Therefore, participants in pilot study were excluded from study sample. It done one month prior to start study.

**Field work:** Data collection extended over a span of 9 months starting from the beginning of January 2023 to the end of September 2023. The researchers utilized tools of study to gather data by visiting intensive care unit department on a thrice-weekly basis at morning and afternoon shifts. There were four distinct phases of the study, which are as follows:

**Assessment Phase:** During this stage, the researchers engaged in nurses' interviews, wherein they elucidated the study's objectives and requested their participation. Subsequently, the researchers used face to face interview to collect demographic data and each nurse filled knowledge questionnaire sheet by self that took about 30- 45 minutes (**tool I**). After that nurses' skills regarding care bundle were observed by researchers according to checklist (**tool II**). In addition, demographic data of patients was

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obtained by the researchers from record. then, they were assessed the patients for Physiological parameters, complications related outcomes signs (**tool III**).

### **Planning Phase:**

Utilizing information acquired during the assessment phase, Construction and formulation of tracheostomy care bundle booklet was done by the researchers after extensive reviewing of related national and international literatures and previous studies. This booklet was written in simple Arabic language and featured accompanying illustrations consisting of theoretical and practical parts according to nurses' educational needs. The researchers also established the number of sessions, their content, different teaching approaches as: Lecture, discussion, demonstration and re-demonstration including a simplified instruction. Training media as: Booklet, pictures, and power point presentation and android or laptop videos was utilized.

**Implementation phase:** In this phase, the researchers distributed studied nurses into smallgroups and each group was about (5-7 nurse) and start application of teaching sessions as each session was about (30-45 minute) including; **first session** clarified information about anatomy and physiology of trachea, tracheostomy as definition, purposes, indication, contraindications, associated early and late complications, types of tracheostomy tubes. This session took about 45minutes. **Second session** included practical skills related to humidification procedures as: Oxygen therapy, nebulizer, how to oxygenate mechanically ventilated patient via stoma continued for 45 minutes. **Third session** included open suctioning technique and how to care of inner cannula lasting for 40minutes. **Fourth session** included stoma care, cuff pressure management (inflation/deflation) and

how to deal with critical situations as decanulation or blockage.

**Evaluation phase:** Evaluate effect of tracheostomy care bundle on nurses' performance and patient' health outcomes using the same tools of pretest was done two times: the first was immediate and the second after one month of implementation.

### **Statistical analysis of the data:**

The Statistical Package for the Social Sciences (SPSS), version 25 was employed to gather, categorize, digitize, organize, and analyze the collected data. Descriptive statistical methods were utilized, encompassing metrics such as mean, standard deviation, frequency, and percentages. Various statistical tests were employed, including the Paired (t) test to compare mean scores within the same sample across different study phases. Additionally, the Chi-square test was employed for numerical and percentage distributions, while the Spearman correlation test (r) was used to determine correlations between the study variables across various study phases. In interpreting the results, a significance level was considered as highly statistically significant  $P \text{ value} \leq 0.01$ . statistically significant.  $P \text{ value} \leq 0.05$ . not statistically significant  $P \text{ value} > 0.05$

### **Results**

**Table (1)** displays socio-demographic characteristics of studied nurses showing that 55.7 % of study subjects aged between 31-40 years with a mean age of  $32.97 \pm 6.50$ , (67.1%) of them were females as well as 72.9% were married, 47.1% of them had bachelor education and 47.1 % had 6-10 years of experience with mean of  $8.08 \pm 3.33$ , 68.6% not attend any training courses related to tracheostomy patient care.

**Table (2)** shows that the total mean score of nurses' knowledge toward care bundle was

improved at immediate post and post 1 month of educational sessions with a high statistically significant differences between pretest, immediate post, and follow up phase observed as p value < 0.001.

**Figure (1)** displays that, total knowledge score of studied nurses was poor at pretest phase 71.4%. While being improved into good at immediate posttest 95.7% and follow up phase 87.1%.

**Table (3):** Compares nurses' practice toward st'mary tracheostomy care bundle at pre, immediate post and follow up phases of study showing a highly statistically significant difference in total practice mean score (p< 0.001).

**Figure (2)** depicts that, total practice score of studied nurses was inadequate at pretest phase 81.4%. While it changed to be adequate at immediate posttest 78.6% and follow up phase 70%.

**Table (4)** illustrates that there was highly statistically significant correlation between studied nurse' knowledge and their practice at pre, immediate post and after one month of tracheostomy care bundle implementation.

**Table (5)** shows that 61.1% of studied patients aged between 51-60 years old with Mean  $\pm$ SD was  $52.388 \pm 7.205$ . 52.8% of them were males. Whereas hypertension was prevailing among 44.4 % of them and 30.6% diagnosed with respiratory failure.

**Table (6)** reveals that tracheostomy patients experienced low clinical risk after care bundle

implementation (38.9%,58.3% respectively) with high statistically significant differences between pre and post bundle implementation observed as p <0.001.

**Table (7)** shows that there were statistically significant differences regarding complications related outcomes among tracheostomy patients between pre and post phases of study observed as p  $\leq$  0.05. in addition, there was high stastically difference between pre and post periods regrding tube dislodgement, stoma site infection, and strioder observed as p <0. 001.

**Figure (3)** depicts that, complications occur among tracheostomy patients at pre bundle program implementation was 55%, then it slightly declined at immediate post and post one month to 26% & 15% respectively.

**Table (1): Frequency and percentage distribution of the studied nurses related to their socio demographic data (n=70).**

Demographic characteristic	n = 70	
<b>Nurses age</b>	<b>No.</b>	<b>%</b>
• 20-30 years	10	14.3
▪ 31-40 years	39	55.7
▪ 41-50 years	14	20
• 51-60 years	7	10
<b>Mean ± SD</b>	<b>32.97±6.50</b>	
<b>Gender</b>		
• Male	23	32.9
• Female	47	67.1
<b>Marital status</b>		
• Married	51	72.9
• Not married	19	27.1
<b>Level of education</b>		
• Diploma (secondary school)	10	14.3
• Technical nursing institute	17	24.3
• Bachelor degree	33	47.1
• Master degree	8	11.4
• Doctorate degree	2	2.9
<b>Years of experience</b>		
• 1-5years	12	17.1
• 6-10years	41	58.6
• 11-15years	17	24.3
<b>Mean ± SD</b>	<b>8.08±3.33</b>	
<b>Attendance of training courses</b>		
• Yes	22	31.4
• No	48	68.6



**Table (2): Distribution of the studied nurses' knowledge level regarding tracheostomy care bundle at pre, immediate post and follow up phase of tracheostomy care bundle implementation (n= 70)**

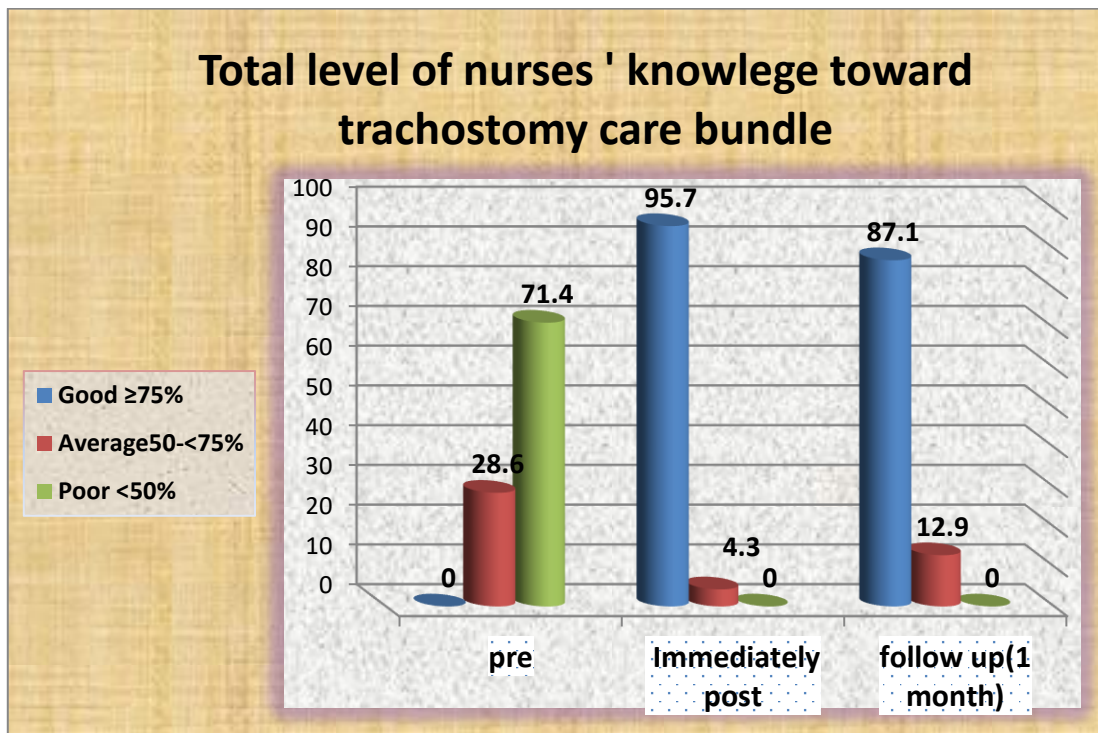
Knowledge items	Pre- test			Immediate post-test			Post 1 month (follow up)			$\chi^2$ 1 (P 1)	$\chi^2$ 2 (P2)
	Good ≥75%	Average 50-<75%	Poor <50%	Good ≥75%	Average 50- <75%	Poor <50%	Good ≥75%	Average 50-<75%	Poor <50%		
	No (%)	No (%)	No (%)	No (%)	No (%)	No (%)	No (%)	No (%)	No (%)		
1-Anatomy and Physiology of Trachea	16(22.9)	12(17.1)	42(60.0)	58(82.9)	8(11.4)	4(5.7)	56(80.0)	12(17.1)	2(2.9)	56.029 <0.001**	62.596 <0.001**
2- Tracheostomy (Definition, Indication, Contra Indication, Complications)	20(28.7)	14(20.0)	36(51.3)	61(87.2)	8(11.4)	1(1.4)	55(78.6)	12(17.1)	3(4.3)	55.498 <0.001**	44.410 <0.001**
3- Types of Tracheostomy Tubes	19(27.2)	13(18.6)	38(54.2)	59(84.3)	9(12.8)	2(2.9)	54(77.1)	13(18.6)	3(4.3)	53.640 <0.001**	46.659 <0.001**
<b>4-Tracheostomy Care Bundle</b>											
• Humidification	23(32.9)	17(24.3)	30(42.8)	66(94.3)	4(5.7)	0(0.0)	65(92.9)	5(7.1)	0(0.0)	58.823 <0.001**	65.591 <0.001**
• Suctioning	0(0.0)	3(4.3)	67(95.7)	66(94.3)	4(5.7)	0(0.0)	60(85.7)	10(14.3)	0(0.0)	133.14 <0.001**	130.769 <0.001**
• Inner Tube Care	1(1.4)	45(64.3)	24(34.3)	64(91.4)	4(5.7)	2(2.9)	63(90.0)	4(5.7)	3(4.3)	133.98 <0.001**	114.592 <0.001**
• Stoma Care or Dressing	2(2.9)	5(7.1)	63(90.0)	69(98.6)	1(1.4)	0(0.0)	64(91.4)	6(8.6)	0(0.0)	128.89 <0.001**	121.333 <0.001**
• Tracheal Cuff Pressure Management	3(4.3)	20(28.6)	47(67.1)	68(97.1)	2(2.9)	0(0.0)	64(91.4)	6(8.6)	0(0.0)	121.234 <0.001**	110.076 <0.001**
• Emergency Equipment for Critical Events	44(5.7)	22(31.4)	44(62.9)	65(92.9)	5(7.1)	0(0.0)	57(81.4)	13(18.6)	0(0.0)	108.631 <0.001**	92.363 <0.001**
<b>Total Mean Score</b>	<b>34.757±7.75</b>			<b>74.100±5.36</b>			<b>70.771±5.189</b>			<b>Paired t test (1) - 34.885 P&lt;0.001**</b>	<b>Paired t test (2) 32.289 P&lt;0.001**</b>

(\*) Statistical significant difference (P ≤ 0.05)

$\chi^2$  (1): Difference between pre- program and immediate post t (1) difference of knowledge mean score at pre and posttest

(\*\*) Highly statistical significant difference (P ≤ 0.001)

$\chi^2$  (2): Difference between pre- program and follow up t (2) difference of knowledge mean score at pre and follow up



**Figure (1): Percentage distribution of studied nurses' total knowledge score through all phases of study (n=70)**

**Table (3): Comparison of the studied nurses' practice related to St Mary's tracheostomy care bundle pre, immediate post and follow up phases of study (n=70)**

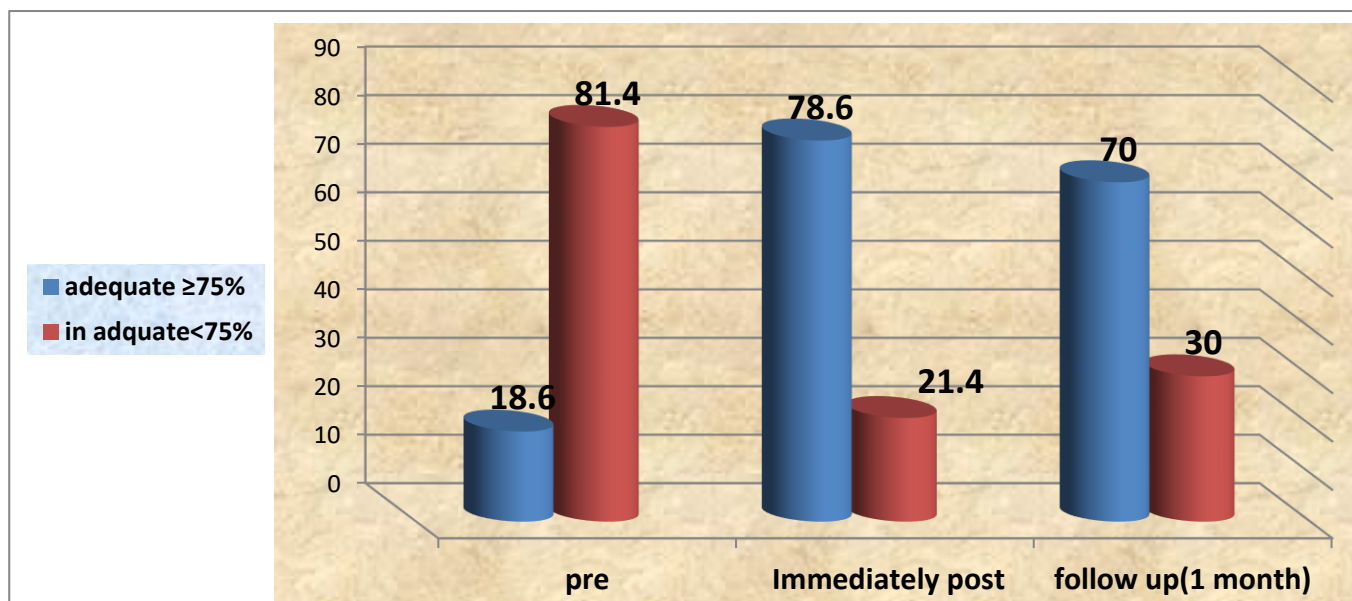
Nurses' practice (St Mary's Tracheostomy Care Bundle)	pre				Immediate post				follow up (post1month)				$\chi^2$ 1 (P 1)	$\chi^2$ 2 (P 2)
	Adequate ≥ 80%		Inadequate < 80%		Adequate ≥ 80%		Inadequate <80%		Adequate ≥ 80%		Inadequate < 80%			
	N	%	N	%	N	%	N	%	N	%	N	%		
<b>1- Humidification</b> Nebulizer	11	15.7	59	84.3	50	71.4	20	28.6	44	62.9	26	37.1	44.188 (<0.001**)	32.612 (<0.001**)
Oxygenation	26	37.1	44	62.9	56	80	14	20	53	75.7	17	24.3	26.493 (<0.001**)	21.179 (<0.001**)
Humidification for ventilated patient via tracheostomy	28	40	42	60	58	82.9	12	17.1	52	74.3	18	25.7	27.132 (<0.001**)	16.800 (<0.001**)
<b>2- Open system suction</b>	17	24.3	53	75.7	46	65.7	24	34.3	42	60	28	40	24.271 (<0.001**)	18.309 (<0.001**)
<b>3- Care of inner cannula</b>	12	17.1	58	82.9	47	67.1	23	32.9	42	60	28	40	35.886 (<0.001**)	27.132 (<0.001**)
<b>4- Stoma care or dressing</b>	18	25.7	52	74.3	47	67.1	23	32.9	43	61.4	27	38.6	24.152 (<0.001**)	18.157 (<0.001**)
<b>5- Cuff pressure management</b> Measuring tracheostomy cuff pressure	38	54.3	32	45.7	58	82.9	12	17.1	53	75.7	17	24.3	13.258 (<0.001**)	7.664 0.013
Tracheostomy cuff deflation	28	40	42	60	57	81.4	13	18.6	54	77.1	16	22.9	25.185 (<0.001**)	19.899 (<0.001**)
Tracheostomy cuff re-inflation	62	88.6	8	11.4	70	100	0	0.0	66	94.3	4	5.7	8.845 0.006*	1.458 0.366
<b>6-Preparations for emergency situations</b>	37	52.9	33	47.1	68	97.1	2	2.9	64	91.4	6	8.6	36.610 (<0.001**)	27.440 (<0.001**)
<b>Total Mean Score of Practice</b>	<b>75.771±20.377</b>				<b>110.385±20.649</b>				<b>105.228±18.632</b>				<b>Paired t test (1) 9.982 P&lt;0.001**</b>	<b>Paired t test (2) 8.993 P&lt;0.001**</b>

(\*) Statistical significant difference (P ≤ 0.05)      (\*\*) Highly statistical significant difference (P ≤ 0.001)

$\chi^2$  (1): Difference between practice at pre- program and immediate post test-

$\chi^2$  (2): Difference between practice at pre- program and follow up t (1) difference of practice mean score at pre and posttest

t (2) difference of practice mean score at pre and follow up



**Figure (2): Frequency distribution of studied nurses regarding their total practice score regarding tracheostomy care bundle through all phases of intervention (n=70)**

**Table (4): Correlation coefficient between total knowledge score and total practice score of the studied nurses' pre, immediately post and after one month of tracheostomy care bundle implementation. (n=70)**

Variables	Total knowledge score					
	Pre		Immediately post		Follow up (after one month)	
	r	P	r	p	r	p
Total practice score	0.235	0.035*	0.238	0.048*	0.242	0.044*

**Table (5): Frequency and percentage distribution of the studied patients according to their personal and medical data (n=36)**

Personal and medical data	N = 36	
	No.	%
<b>Age (years)</b>		
• 30-40	4	11.1
• 41-50	10	27.8
• 51-60	22	61.1
<b>Mean ± SD</b>	<b>52.388±7.205</b>	
<b>Gender</b>		
• Male	19	52.8
• Female	17	47.2
<b>Comorbidity</b>		
• Diabetes mellitus	12	33.3
• Hypertension	16	44.4
• Kidney disease	3	8.3
• Liver disease	2	5.6
• Cardiac disease	3	8.3
<b>Diagnosis</b>		
• Respiratory failure	11	30.6
• Brain tumor	5	13.9
• Poly-trauma	3	8.3
• Heart failure	4	11.1
• Brain Hemorrhage	10	27.8
• Diabetic ketoacidosis	3	8.3

**Table (6): Frequency and percentage distribution of total clinical risk (for physiological parameters) among studied patients using National Early Warning Score before and after implementing tracheostomy care bundle**

Clinical risk (for physiological parameter)	Pre		Immediately Post		Post one month		X <sup>2</sup> 1 P value	X <sup>2</sup> 2 P value
	N	%	N	%	No	%		
<b>Low risk</b> (aggregate score 1 to 4)	4	11.1	14	38.9	21	58.3	9.502 0.009*	27.422 0.000**
<b>Moderate risk</b> ( 5-6 score)	11	30.6	12	33.3	13	36.1		
<b>High risk</b> (aggregate score of 7 or more)	21	58.3	10	27.8	2	5.6		

**X2: Chi-square**

**p= p-value**

**χ<sup>2</sup> 1(P 1) between pre and post implementation**

**χ<sup>2</sup> 2(P 2) between pre and post 1 month)**

**In-significance (P > 0.05)**

**Significance\* (P≤0.05)**

**Highly significance\*\* (P<0.001)**

## Tracheostomy Care Bundle: its Effect on Nurse's Performance and Patient' Health Outcomes

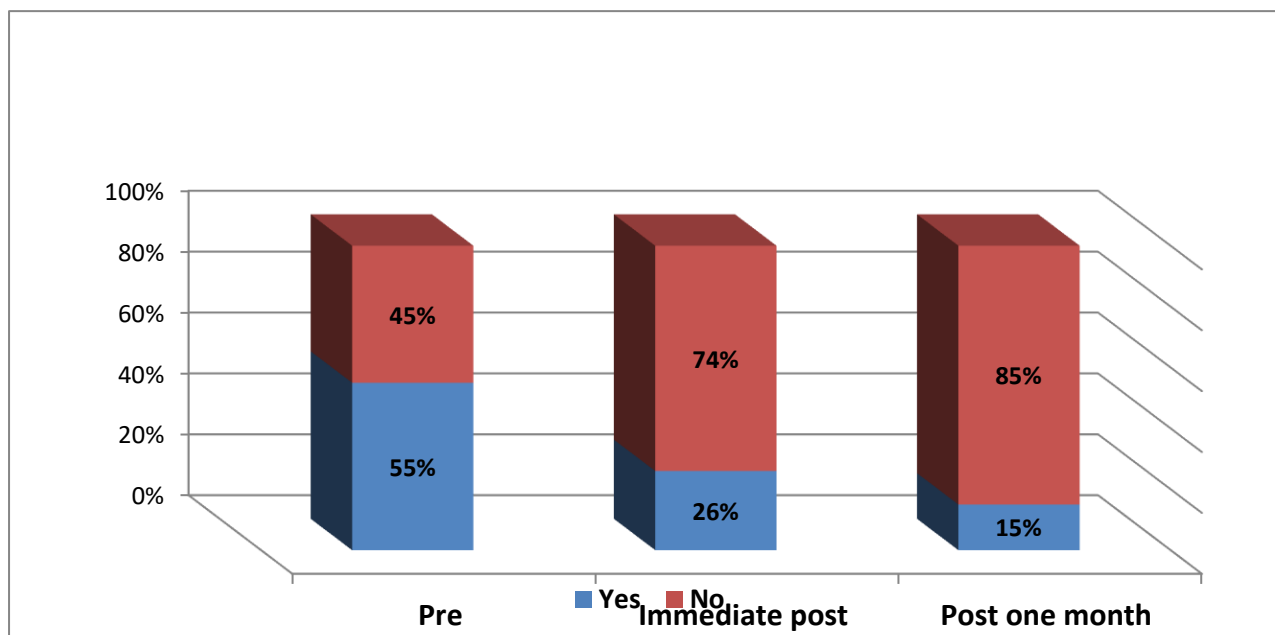
**Table (7): Frequency and percentage distribution of studied patients regarding complications related outcomes pre and post implementing tracheostomy care bundle (n=36)**

Complication		Pre		Immediately Post		Post one month		X <sup>2</sup> P value	X <sup>2</sup> P value
		N	%	N	%	N	%		
<b>Signs of tube dislodgment or obstruction</b>									
The tube for loose ties	Yes	27	75	11	30.6	7	19.5	14.266 0.000**	22.91 0.000**
	No	9	25	25	69.4	29	80.5		
Low airway pressure alarms	Yes	23	63.9	14	38.9	6	16.7	4.503 0.03*	16.686 0.000**
	No	13	36.1	22	61.1	30	83.3		
Low expiratory volume alarms on the mechanical ventilator	Yes	20	55.6	8	22.2	5	13.9	8.416 0.007*	17.787 0.000**
	No	16	44.4	28	77.3	31	86.1		
Low cuff pressure measurement using cuff pressure manometer at 20-30 cm H <sub>2</sub> O	Yes	14	38.9	9	25	5	13.9	1.597 0.206ns	5.791 0.016*
	No	22	61.1	27	75	31	86.1		
Hypoxia	Yes	18	50	8	22.2	6	16.7	6.020 0.02*	9.000 0.003*
	No	18	50	28	77.3	30	83.3		
Increased work of breathing	Yes	21	58.3	13	36.1	9	25	3.567 0.05*	8.299 0.004*
	No	15	41.7	23	63.9	27	75		
Noisy breathing	Yes	18	50	9	25	6	16.7	4.800 0.05*	9.000 0.003*
	No	18	50	27	75	30	83.3		
Inability to pass a suction catheter	Yes	15	41.7	6	16.7	4	11.1	5.445 0.02*	8.651 0.003*
	No	21	58.3	30	83.3	32	88.9		
<b>Signs of respiratory tract infection</b>									
Increase in WBC count	Yes	24	66.7	7	19.4	4	11.1	16.371 0.000**	23.377 0.000**
	No	12	33.3	29	80.6	32	88.9		
Positive sputum culture for microorganism	Yes	27	75	13	36.1	6	16.7	11.025 0.001*	24.671 0.000**
	No	9	25	23	63.9	30	83.3		
Increase need for suctioning	Yes	25	69.4	13	36.1	5	13.9	8.025 0.004*	22.857 0.000**
	No	11	30.6	23	63.9	31	86.1		
X-ray changes	Yes	27	75	15	41.7	8	22.2	8.229 0.004*	20.071 0.000**
	No	9	25	21	58.3	28	77.8		
<b>Signs of stoma site infection</b>									
Skin redness or discoloration	Yes	15	41.7	5	13.9	3	8.3	6.932 0.008*	10.667 0.001*
	No	21	58.3	31	83.1	33	91.7		
Swelling	Yes	9	25	8	22.2	3	8.3	0.077 0.500 ns	3.600 0.05
	No	27	75	28	77.8	33	91.7		
Pain	Yes	20	55.6	8	22.2	6	16.7	8.416 0.004*	11.799 0.001*
	No	16	44.4	28	77.8	30	83.3		
Purulent discharges	Yes	15	41.7	6	16.7	6	16.7	5.445 0.018*	5.445 0.02*
	No	21	58.3	30	83.3	30	83.3		
<b>Signs of respiratory distress</b>									
Movement of the chest during ventilation	Yes	15	41.7	7	19.4	4	11.1	4.189 0.03*	8.651 0.003*
	No	21	58.3	29	80.6	32	88.9		
Low arterial saturation	Yes	13	36.1	7	19.4	3	8.3	2.492 0.09ns	8.036 0.005*
	No	23	63.9	29	80.6	33	91.7		
Skin color of the patient (is he turning blue)	Yes	15	41.7	6	16.7	5	13.9	5.445 0.018*	5.79 0.01*
	No	21	58.3	30	83.3	31	86.1		
Increased pulse/respiratory rate	Yes	21	58.3	10	27.8	6	16.7	6.854 0.008*	13.333 0.000**
	No	15	41.7	26	72.2	30	83.3		
Use of accessory muscles	Yes	25	69.4	16	44.4	10	27.8	4.589 0.02*	12.510 0.000**
	No	11	30.6	20	55.6	26	72.2		
Reduced chest movement	Yes	23	63.9	10	27.8	5	13.9	9.455 0.002*	17.126 0.000**
	No	13	36.1	26	72.2	31	86.1		
Stridor	Yes	24	66.7	7	19.4	4	11.1	16.371 0.000**	23.377 0.000**
	No	12	33.3	29	80.6	32	88.9		

$\chi^2$  1(P 1) between pre and post implementation       $\chi^2$  2(P 2) between pre and post 1 month)

In-significance (P > 0.05)

significance\* (P≤0.05) highly significance\*\* (P<0.001)



**Figure (3): Frequency distribution of complications experienced by tracheostomy patients at pre and post care bundle program implementation (n=36)**

### Discussion

Tracheostomies are ubiquitous, however differences in training and knowledge gaps between institutions, fields, and professions raise the likelihood of tracheostomy-related problems. Despite the prevalence of tracheostomies, there is substantial diversity in tracheostomy care across each country. Furthermore, there is no standardized training for healthcare personnel who give tracheostomy care on a regular basis (Zaga et al., 2023).

At the outset, healthcare personnel have varying levels of expertise about the function and care of tracheostomies. Inadequate tracheostomy tube care can lead to secretion accumulation which can cause sudden airway obstruction and if left untreated, asphyxia death can occur (Bak, 2022).

**Regarding age of studied nurses:** The current study revealed that, more than half of studied nurses their age ranged from 31-40 years old.

This finding is consistent with what was reported by **Kim and Julie (2023)** who studied about "Guidelines for care of patients with a tracheostomy." and mentioned that most of nurses who working in intensive care unit were between 30 and 40 years old.

While, this finding is inconsistent with **Eltaib, et al., (2021)** who studied about "Effect of Tracheostomy Care Guidelines on Internship Nurses Students' Performance and Confidence Level", and reported that the majority of the studied subjects' age was between 22-24 years old. This finding is also not in the same line with **Beshay et al., (2020)** who studied about "Nurses' Performance Regarding Care of Patients with Tracheostomy", which reported that less than half of the studied nurses' age were between 30 and 40 years old. As well as **Khanum et al., (2022)** and found that near to half of the studied nurses age was between 26-30 years old in a study entitled "Assessment of knowledge regarding tracheostomy care and management of early complications among

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healthcare professionals". This explains that they are old graduated and tolerate the nature of the work as hospital administration not assign newly graduated nurses to intensive care unit as critical area and required highly experienced personnel.

**As regard to gender**, the current study results revealed that more than two third of studied nurses were females. From the researchers' point of view, this is may be due to the greater fraction of the nurse in Egypt was female and my also related to the studying of nursing in Egypt were exclusive for female only till few years ago.

This finding agrees with study results of **Nabil et al., (2022)** about " Effectiveness of Training Program regarding Tracheostomy Care on Nurses Performance at Intensive Care Unit" and **Mahfoz, (2022)** about "Attitude and practices of tracheostomy care among nursing staff in Saudi Arabia", they reported that most of their studied nurses were female that may be due to elevated number of nurses among female.

**Concerning to marital status**, the present study finding revealed that more than two third of studied nurses were married. This finding goes in the same line with **Beshay et al., (2020)** who reported that the majority of the studied nurses were married. While in contrast with **Suliman et al., (2023)** who found that the majority of the studied nurses were single.

**In respect to the level of education**, the result of the present study revealed that near half of studied nurses were have bachelor degree.

This finding agrees with a study done by **Alnemare, (2020)** about " Nurses Training and confidence in Management of Tracheostomy Patients in a Community

Hospital in Saudi Arabia, " and reported that the most of nurses were having bachelor degree. Similarly, this result is in agreement with **Yelverton et al., (2022)** who studied about "Effectiveness of a standardized education process for tracheostomy care." and mentioned that, the number of diploma schools has declined in the recent years due to trend moving nursing education into the academic setting. This is in agreement with **Gundo, (2021)** who reported that, the nurses in critical care unit have a need to improve their educational level and **Beshay et al., (2020)** who showed that more than half of the study nurses were had technical nursing degree.

**Regarding years of experience** in intensive care unit, the current study showed that less than half of studied nurses had experience up to five years to less than ten years. From the researchers' point of view, this could be due to work stress, severity of patient condition and occupational hazards that facing them in critical care unit, all of this prevent nurses from continuing work in the critical care unit.

This finding is in line with a study supported by **Mahfoz (2022)** who reported that more than one third of the studied nurses with 6-10 years of experience. Conversely, in a study carried out by **Abu-Sahyoun et al., (2023)** which entitled " Critical Care Nurses' Knowledge of Tracheostomy Care" they stated that more than half of the studied nurses were from 5 - 10 years of experience.

**As regard to having previous training courses**, the current study demonstrated that, more than two third of nurses under study had no previous training courses about caring for patients with tracheostomy. From the researchers' point of view, this may be due to staff shortage, work load, lack of training courses about the tracheostomy and lack of



time in critical care unit. This result is similar to **Zaga et al., (2023)** who reported in their study about " Defining effective communication for critically ill patients with an artificial airway " that the majority of the study subjects had no previous training courses.

**In relation to studied nurse's knowledge:** the result of the present study revealed that the studied nurses had a poor level of knowledge pre tracheostomy care bundle implementation, while most of them had a good level of knowledge immediate post and post 1 month of tracheostomy care bundle implementation. From the researchers' point of view, workload, insufficient competence, being overloaded by more jobs, and working longer hours could all contribute to this.

This result supported by **Gaterega et al., (2021)** who studied about " Nurses knowledge and practices regarding tracheostomy care " and reported that the degree of knowledge on tracheostomy care among nurses was low pre program implementation, which differs with the findings of **Dhaliwal et al., (2018)** who studied about "A Descriptive Study to assess the knowledge and skills on tracheostomy care among staff nurses " and found that near half of nurses had good knowledge.

According to **Khanum et al., (2022)** who studied about "Assessment of knowledge regarding tracheostomy care and management of early complications among healthcare professionals " and found that the nurses demonstrated a major improvement when the intervention was implemented. This could be due to the training program's good impact on nurses' knowledge of tracheostomy care.

**In relation to studied nurses' practice:** The current study illustrates that the majority of the studied nurses had inadequate practices

pre tracheostomy care bundle implementation, but improved to be adequate practice at immediate post and post 1 month of tracheostomy care bundle implementation.

The result of the current study is in agreement with **Chen et al., (2021)** who studied about " Intensive care nurses' knowledge and practice of evidence based recommendations" and reported Prior to the implementation of the intervention, the majority of study nurses had unsatisfactory tracheostomy care practices, which may have been caused by poor skills, a heavy workload, a lack of focus, and interruptions but improved to satisfactory tracheostomy care practices post implementation of the intervention.

**Concerning the connection between the nurses' knowledge and skills.** The current study discovered that there was a significant correlation between nurses' total knowledge and total practice pre as well as post tracheostomy care bundle implementation; it might be related to lack of training programs. So, from the researchers' point of view, the hospital should concern of providing continuous training for intensive care unit nurses to gain and update their knowledge and practice as such, they are critical to the provision of quality care.

This result agrees with **Bahig et al., (2023)** who reported in their study about " Effectiveness of TRACHE Care Bundle Implementation on the Nurses' Performance and Improving Tracheostomy Management Safety " that there was a statistically significant positive correlation between the total practice level and the overall degree of knowledge held by nurses. This result also is in in line with that of **Dhaliwal et al., (2018)** who found a strong correlation between knowledge and practice. As well as **Amer et al., (2023)** which stated in a study about "

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Cross Sectional Study of Tracheostomy Patient' care quality " that there was a statistically significant positive correlation between total nurses' knowledge and total nurses' practice, which corroborated this finding.

### **Demographic characteristics of the studied patients.**

**Regarding age of studied patients:** The current study revealed that, more than half of studied patients were male and their age ranged from 51-60 years old.

This result agrees with **Nyanzi et al., (2023)** who carried out a study about "Tracheostomy-related indications, early complications and their predictors among patients in low resource settings" and sated that the mean age of all patients was 56.5 years, and more than half of them were male and were married.

This result is in disagreement with **Mosaad et al., (2017)** who studied bout "Quality of nursing care on Patients with Tracheostomy" and founded that more than half of patients age were less 35years, and was married.

**Concerning patients' diagnosis and comorbid disease;** This study displays that near half of studied patients had hypertension disease and were diagnosed with respiratory failure.

This finding agrees with **Mosaad et al., (2017)** who reported that the majority of studied patients were diagnosed with respiratory failure. Also, this result is supported by **Chen et al., (2021)** who stated that more than one third of the patients were had hypertension disease and were diagnosed with respiratory failure.

This result disagrees with **Woods et al., (2023)** who stated that more than two third of studied patients were diagnosed with heart

failure and had diabetes mellitus as a comorbid disease.

**As regard to patient' health outcomes:** the present study shows that more than half of tracheostomy patients experienced low clinical risk after care bundle implementation with high statistically significant differences between pre and post bundle implementation. This result agrees with **Mc Mahon et al., (2023)** who revealed in study entitled "Patient-Centred Outcomes Following Tracheostomy in Critical Care" that nearly half of studied patients experienced stable physiological parameters with low clinical risks post care provided by health care team. While, this result disagrees with **Bernasconi et al., (2022)** who stated in study titled 'Outcome of Tracheostomy for Ventilated Patients during Covid-19 Pandemic' that more than two thirds of patients had decreased respiratory rate and oxygen saturation inspite of care provided.

**As regard incidence of complications related outcomes pre and post implementing tracheostomy care bundle:** The present study shows that complications occured among tracheostomy patients slightly declined after care bundle to 26% & 15% with high stastically difference between pre and post periods regrding tube dislodgement, stoma site infection, and strioder observed as  $p < 0.001$ .

This finding is consistent with **Suliman et al., (2023)** who depicated in study entitled "Effect of Implementing Tracheostomy Tube Care Bundle on Outcomes of Critically ill Patients" that, Implementation of tracheostomy tube care bundle interventions significantly decreased the complications such as: stoma site infection, bleeding signs and need for suctioning

At the same line, **Young et al., (2021)** who reported that there were high statistically

significant differences between pre and post implementation of educational program regarding outcomes. These include time to ventilator liberation, time to decannulation, hospital length of stay, and discharge disposition.

This result is in the line with **Olton et al., (2019)** who studied about " Outcome Evaluation of Patients Requiring Tracheostomy in an Intensive Care Unit in Trinidad" and stated that the complications related outcomes were less severe post guidelines implementation.

This result disagrees with **Nyanzi et al., (2023)** who founded that there were minor differences in the occurrence of complication related outcomes rate between pre and post educational session implementation.

#### **Conclusion:**

Based on the findings of the current study, it can be concluded that: The application of tracheostomy care bundle for nurses was successful in enhancing health outcomes of patients.

#### **Recommendations:**

- Developing a system of periodical nurses' evaluation to determine strategies of upgrading their knowledge and enhancing their practice regarding tracheostomy care.
- Developing tracheostomy care bundle booklet or poster should be involved in critical units.
- lose supervision and monitoring are needed to ensure quality care of provided.
- Undergraduate critical care nursing courses should handle the concept of tracheostomy tube care bundle focusing on its positive outcomes.

- trict compliance with infection control measures is required to prevent respiratory and stoma site infections.

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## حزمة الرعاية الخاصة بالشق الحنجري : تأثيرها على أداء التمريض والنتائج الصحية للمرضى

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يعتبر المرضى الذين يعانون من وجود الشق الحنجري معرضين لخطر كبير المضاعفات ولديهم العديد من المضاعفات التي يجب على الممرضات مراعاتها. وقد هدفت الدراسة الي تقييم مدى تأثير حزمة الرعاية الخاصة بالشق الحنجري على أداء التمريض والنتائج الصحية للمرضى. تستخدم الدراسة تصميم البحث شبه التجريبي. وقد أجريت الدراسة في مستشفى بنها الجامعي في وحدة العناية المركزة على عينة ملائمة مكونة من 70 ممرضة و36 مريضاً باستخدام ثلاث أدوات: استبيان ذاتي، وقائمة مراجعة مراقبة حزمة رعاية الشق الحنجري واستمارة النتائج الصحية للمريض. أظهرت النتائج أن مجموع درجات المعرفة لدى الممرضات كانت ضعيفة في مرحلة الاختبار القبلي 71.4%. بينما تم التحسن إلى جيد في الاختبار البعدي المباشر 95.7% ومرحلة المتابعة 87.1%. بالإضافة إلى ذلك، كانت درجة الممارسة الإجمالية للممرضات الخاضعين للدراسة غير كافية في مرحلة الاختبار القبلي بنسبة 81.4%. بينما تغيرت لتصبح كافية في الاختبار البعدي المباشر 78.6% وفي مرحلة المتابعة 70%. وعلى نفس المنوال، عانى أكثر من نصف مرضى الشق الحنجري من مخاطر ومضاعفات سريرية منخفضة بعد تنفيذ حزمة الرعاية مع وجود فروق ذات دلالة إحصائية عالية بين تنفيذ الحزمة قبل وبعدها والتي لوحظت عند  $P < 0.001$ . الاستنتاج: إن تطبيق برنامج حزمة رعاية القصبة الهوائية للممرضات كان ناجحاً في تحسين نتائج المرضى. واوصت الدراسة بأنه يجب أن يتم تطوير كتيب أو ملصق حزمة رعاية الشق الحنجري في الوحدات الحرجة مع تحسين مستوى جلسات التدريب التمريضي لتحسين النتائج الصحية للمريض وجودة الرعاية المقدمة.