

Effectiveness of TRACHE Care Bundle Implementation on the Pediatric Nurses' Performance and Improving Pediatric Tracheostomy Management Safety

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Abstract

Background: Pediatric tracheostomies are associated with risks and it is increasingly being used to treat upper-airway congestion in kids with complicated and long-term illnesses.. **Aim:** to evaluate the effectiveness of TRACHE care bundle implementation on the Pediatric Nurses' performance and improving pediatric tracheostomy management safety. **Method:** The design used was quasi-experimental. **Sample:** A convenience sample of all available bedside/ working nurses and children undergoing tracheal intubation at Neonatal and Pediatric Intensive Care Units at Aswan university hospital. **Data collection** utilized three tools: A structured interview questionnaire encompassing biosocial data for nurses and children, nurses' knowledge, an observation checklist to assess nurse practices regarding TRACHE care bundle guideline, and an assessment of checklist observation related pediatric tracheostomy management safety . **Results:** According to this study, the majority of nurses had inadequate tracheostomy care knowledge and practice before program implementation (80.4% and 64.3%, respectively), and these levels sharply dropped right after the program (37.5% and 32.1%, respectively). **Conclusion:** there was significant improvement in nurse's knowledge and practices regarding tracheostomy care post the program implementation which supported the study hypothesis. **Recommendation: educational training program should be applied to a broader sample of nurses drawn from different regions of Egypt to improve the effectiveness of their tracheostomy care**

Keywords: TRACHE Care Bundle, Nurses' Performance, Pediatric Tracheostomy Management Safety.

Introduction:

A tracheostomy is a surgical aperture established in the operating room (OR) while the patient is sedated. This entry point is through the neck into the trachea (windpipe). To provide a stable airway to breathe, a tracheostomy tube is inserted via this aperture (stoma) (*Castro-Nez et al.,2022*). In children with chronic and severe illnesses, tracheostomy is increasingly used to treat upper respiratory blockage, aberrant ventilator drive, prolonged ventilation, and irreversible neuromuscular disorders. (*Watters, 2017*).

Pediatric tracheostomy incidence has fluctuated throughout the last century; however, Pediatric tracheostomies have increased recently as a result of greater survival of critically ill children, and neurologically injured neonates. (*Doherty et al., 2018*).

Children may require a tracheostomy for a variety of reasons. The most common is to alleviate severe breathing difficulties caused by a blockage or restriction of the upper airway. Other causes include a child requiring to be linked to a machine (ventilator) to aid with their breathing or need to have mucus suctioned from their airway regularly if they can't swallow their saliva properly (*Zaga et al.,2023*).

The rationale for pediatric tracheostomy has developed throughout time, influencing the occurrence of pediatric tracheostomy in our hospitals and communities, as well as the baseline features and comorbidities of these children. Vaccination programs, as well as advances in aesthetic skills and equipment, have considerably reduced the necessity for emergency tracheostomy owing to airway congestion, particularly as a result of upper

airway infection (*Mishra et al., 2022*). Tracheostomy has several advantages, including patient comfort, effective airway aspiration, decreased airway resistance, increased patient mobilization, the capacity to speak and feed orally, and a stable airway (*Bak, 2022*). It also allows patients to have home ventilation. These benefits, in theory, reduce the time spent on ventilation, in the PICU, and in the hospital, however clinical research contradicts this. Although the researchers emphasize that opening a tracheostomy in 4 days may aid in the weaning of breathing in blunt traumas, the length of ventilation (*Grey et al., 2021*).

A crucial role of tracheostomy tubes is in the control of pediatric airways. The importance of postoperative care in reducing linked morbidity and death was highlighted by early pioneers (*Woods et al., 2019*). The most common causes of tracheostomy-related deaths include inadvertent de-annulation, tube occlusion, and tube misplacement. There are two categories of tracheostomy complications: early and delayed events. *Schmidt et al. (2020)* list the following as early complications: mucosal injury, esophageal injury, formation of a false passage, mucus plugging, accidental decannulation, hemorrhage, cricoid injury, recurrent laryngeal nerve injury, pulmonary edema, respiratory arrest, pneumothorax, pneumonia mediastinum, subcutaneous emphysema, and respiratory arrest.

Proper and comprehensive management both perioperative and intraoperative can help prevent the majority of these problems. The following are delayed complications: mucus clogging, stromal granulation, tracheocutaneous fistula, tracheal granuloma, suprastomal collapse, subglottic stenosis, haemorrhage (stomal, tracheal, and tracheoinnominate fistula), tracheoesophageal fistula, and swallow dysfunction. Silver nitrate cautery may occasionally be necessary to treat stomal granulation, although other treatment options include more frequent dressing and tube changes and careful wound care (*Woods et al., 2023*). Even though tracheostomy management is a crucial competency for effective tracheostomy care, contemporary medical residents frequently don't get much training in this field. It is difficult to provide

tracheostomy care in settings with limited resources because it requires a high level of continuing care, staff education, and funding. (*Sandler & Associates, 2020*).

The following safety measures should be used by pediatric nurses to enhance tracheostomy management: When providing care for a patient who has a tracheostomy, a nurse must be well-versed in airway management and keep a close eye on the patient's respiratory status. In cases of emergency, prompt action is necessary to prevent respiratory arrest. This includes evaluating the possibility of using a smaller tracheostomy tube, reevaluating leaks after patient positioning adjustments, assessing for tube displacement and/or tracheostomy tube/pilot malfunction, and checking for tracheomalacia, incorrect sized tracheostomy tube, and malposition of the tracheostomy tube (*Zaga et al., 2020*).

Significance of the study:

The hazards and consequences associated with pediatric tracheostomies are approximately two to three times higher than the rates of morbidity and death found in adult studies. Complications directly associated with pediatric tracheostomies have a 0.7% fatality rate. The majority of adverse events that are documented do not happen right after surgery; instead, issues that arise more than a week after insertion are four times more likely (*Volsko et al., 2021*).

By maintaining the skin's integrity around the tracheostomy stoma, routine pediatric tracheostomy care helps prevent problems, reducing infection, and maintaining airway patency. Adhering to evidence-based guidelines for the mature tracheostomy patient reduces practice variance and improves patient outcomes across all healthcare environments. Since children who have tracheostomies are at a higher risk of morbidity and death, it is especially crucial to incorporate evidence-based care into practice (*Lawrence et al., 2021*). So that the study aim was to evaluate effectiveness of TRACHE care bundle implementation on improving pediatric tracheostomy management safety in Neonatal and Pediatric intensive care units .

Aim of the Study

This study was conducted to evaluate the effectiveness of TRACHE care bundle implementation on the Pediatric Nurses' performance and improving pediatric tracheostomy management safety, through:

- Assessment of nurses' knowledge, practices and pediatric tracheostomy management safety at Neonatal and Pediatric Intensive Care Units before TRACHE care bundle guideline implementation.
- Design and implementation of TRACHE care bundle guideline for nurses at Neonatal and Pediatric Intensive Care Units.
- Evaluation of nurses' knowledge, practices and pediatric tracheostomy management safety at Neonatal and Pediatric Intensive Care Units after TRACHE care bundle guideline implementation.

Research hypothesis:

After implementing TRACHE care bundle guideline for studied nurses at Neonatal and Pediatric Intensive Care Units, the nurses' performance and pediatric tracheostomy management safety would be significantly improved compared to previously.

Methods

The current study employed a quasi-experimental research design to investigate the impact of a targeted intervention within the Neonatal and Pediatric Intensive Care Units (NICU&PICU) at Aswan University Hospital. The quasi-experimental design was chosen for its practical applicability in the context of the NICU&PICU, where random assignment of participants to different groups may pose challenges. This design allowed for the assessment of the intervention's effects on a single group of participants without the need for a control group. The study aimed to evaluate the effectiveness of TRACHE care bundle implementation on the Pediatric Nurses' performance and improving pediatric tracheostomy management safety Neonatal and Pediatric Care Units.

The settings for this study were the NICU& PICU at Aswan University Hospital, a critical

healthcare environment dedicated to the specialized care of children requiring intensive medical attention. The choice of this setting was deliberate, given the unique challenges and considerations associated with critical care. The NICU& PICU settings ensured a focused examination of the intervention's impact on nurses' knowledge, practices and, by extension, evaluate Pediatric tracheostomy management safety.

The sample size for this study consisted of 56 nurses and 28 children. All 56 nurses working within the NICU& PICU during the study period were included in the research, ensuring a comprehensive representation of the healthcare professionals directly involved in critical care. Additionally, all 28 children present in the NICU& PICU throughout the data collection period were included in the study. The decision to involve the entire nursing and neonatal population during the specified period was based on the practical constraints of the NICU& PICU settings and aimed to provide a holistic perspective on the outcomes of interest.

Inclusion criteria for nurses included all those currently working in the NICU& PICU, whereas inclusion criteria for children included both sexes, any age, and those undergoing tracheal intubation and tracheostomies performed by surgeons using the surgical procedure those present in the NICU& PICU during the data collection period. The study employed a practical sample technique that accounted for the pragmatic constraints inherent in the NICU and PICU contexts. Exclusion criteria were not clearly mentioned, but the study design and sampling approach addressed the need for realistic and workable participant selection within the specific environment of Aswan University Hospital's Neonatal and Pediatrics Intensive Care Units.

Data collection tools:

Three tools were used to collect data:

Tool (I): The Questionnaire of Structured Interviewing:

Following an extensive examination of relevant materials, the researcher thoroughly developed it. The item in question is

constructed up of two parts that are written in Arabic and perform as a measurement device:

Part (1): Socio-demographic data of the studied nurses: this included information regarding the participants' characteristics details such as name, age, gender, years of experience, level of education, and prior tracheal nursing care training.

Part (2): Socio-demographic characteristics of studied children, it included data related to subjects' characteristics such as name; age, sex, length of stay.

Tool (II): Assessment of the studied nurses' knowledge and practice:

Part (1): Nurses's knowledge assessment regarding pediatric tracheostomy after the literature review (*Agarwal et al., 2016; Mosalli et al., 2022*). It included ten multiple-choice questions covering the definition of a tracheostomy, the purpose, the indication of a tracheostomy, the parts of a tracheostomy, the size of a pediatric tracheostomy, the time that tracheostomy tube tie changes, indications that a child needs their tracheostomy suctioned, elements of tracheostomy care bundle, pediatric tracheostomy care ,role of nurse in maintaining a tracheostomy management safety.

The scoring system to assess nurses' knowledge is designed to provide a nuanced assessment. Each accurate and complete response earns two points, an incomplete but correct answer earns one point, and incorrect or unknown answers get zero points. The total score is then translated to a percentage, enabling a clear assessment of the nurses' overall knowledge level. A score of 75% or greater is considered satisfactory, suggesting a thorough comprehension of pediatric tracheostomy, whereas a score of less than 75% is considered unsatisfactory, indicating areas that may require additional attention or education. This methodical and comprehensive technique ensures a thorough assessment of the nurses' knowledge levels in the PICU and NICU.

Part (2): Pediatric TRACHE Care Bundle guideline checklist created by (Hall et al., 2017). It covered six major subjects,

including tapes to secure the tube (4 items), the resuscitation process (4 items), and keeping the airway clear by utilizing the right suction method (4 items). Stoma and neck maintenance (3 items), humidity is required to keep the tube clear (2 items), and an emergency box should always be carried by the youngster (2 items).

The scoring system entails a detailed review of each item on the checklist. The pediatric TRACHE Care Bundle guidelines in each of the six primary subjects are meticulously analyzed, allowing for a nuanced comprehension of the nurses' practices. The scoring mechanism will most likely involve allocating points to each item, with a higher score indicating greater compliance with the recommended pediatric TRACHE Care. The questionnaire was constructed as follows: The correct answer received a "ONE," while the incorrect answer received a "ZERO." The practice level was classified as follows based on the scoring system used: an add-adequate level is 75% and an in-adequate level is 75%. This methodical technique not only assists in finding areas that may require development but also serves as a guideline.

Tool III: Checklist observation of Pediatric tracheostomy management safety created by *Shah et al., 2020* . It included ensuring the tracheostomy tube is secure, maintaining airway patency (15 items), monitoring the child's O2 saturation levels (7 items), and securing Velcro tapes used to attach the tracheostomy tube (6 items).

The designed observational checklist's scoring system included two responses: "done" as opposed to "not done." "Done" received a score of "ONE," while "not done" received a score of "ZERO." The performance level was classified as follows based on the scoring system used: satisfactory level is more than 75% and unsatisfactory level is less than 75%.

Procedure:

In the preparatory phase of this research endeavor, an extensive review of literature was undertaken, spanning both historical and contemporary sources. This comprehensive exploration covered a spectrum of aspects related

to TRACHE care bundle guidelines, the Pediatric Nurses' performance, and improving pediatric tracheostomy management safety. The literature review incorporated diverse sources, including books, articles, periodicals, websites, textbooks, scientific journals, and magazines. This exhaustive review aimed to foster a deep understanding of the research problem and facilitate the development of robust study instruments. By delving into a wide range of literature, the researchers gained insights into the intricacies of pediatric tracheostomy management safety by TRACHE care bundle guidelines implementation, emerging trends, and existing gaps in knowledge, laying a strong foundation for the subsequent phases of the study.

Following the development of study instruments, the validity of these tools was rigorously examined in the second phase. A panel comprising three pediatric nursing specialists and two pediatric medicine specialists meticulously evaluated the tools. This evaluation focused on aspects such as clarity, relevance, applicability, comprehensiveness, and overall understanding. The insights from this expert jury led to minor adjustments in the tools to enhance their precision and effectiveness. This meticulous validation process ensured that the study instruments were well-designed and aligned with the objectives of the research.

The reliability of the tool was assessed in the third phase. The Cronbach alpha coefficient was used to assess the internal consistency of the instruments, yielding a value of 0.781 for nurses' knowledge. This robust coefficient indicated a high level of internal consistency and reliability within the tools, bolstering confidence in their ability to yield accurate and consistent results. Subsequently, a pilot study was conducted on 10% of the total number of nurses in the identified settings before the commencement of the data collection phase. This pilot study served multiple purposes, including evaluating the precision, applicability, and practicality of the research instruments, determining the time required for tool completion, and identifying potential challenges in data collection. The pilot study findings permitted essential revisions to the research tools, assuring their maximum performance. Importantly, pilot research participants were not included in the final study sample, ensuring the integrity of the future data

gathering and analysis phases. Overall, the rigorous processes in the preliminary, validation, and pilot stages contributed to the study process's validity and reliability.

The fieldwork for this study unfolded through a systematic progression of Phases include assessment, planning, implementation, and evaluation. During the evaluation phase, the researcher made initial contact with each study site, performed introduction interviews with participating nurses, and obtained their informed consent. The Neonatal and Pediatric Intensive Care Unit (NICU) then collected baseline data, encompassing an evaluation of the effectiveness of TRACHE care bundle implementation on the Pediatric Nurses' performance and improving pediatric tracheostomy management safety. From May to July 2023, this phase lasted three months, with data collection tools lasting about 30 minutes for the self-administered questionnaire and 15 minutes for the observational checklist. The study venues were visited three times per week (Monday, Tuesday, and Thursday) between 9:00 a.m. and 2:00 p.m.

During the planning phase, an educational program was developed based on a thorough assessment of the nurses' needs in relation to knowledge and practices and improving pediatric tracheostomy management safety. This program incorporated both theoretical and practical components covering essential aspects of TRACHE care bundle, the Pediatric Nurses' performance and Pediatric tracheostomy management safety.

Theoretical topics ranged from the definition of a tracheostomy to the role of the nurse in maintaining a tracheostomy management safety, while practical elements encompassed tapes to secure the tube, the resuscitation process, and keeping the airway clear by utilizing the right suction method. Stoma and neck maintenance, humidity is required to keep the tube clear, and an emergency box should always be carried. The researcher evaluated nurses' knowledge, practices, and Pediatric tracheostomy management safety during multiple shifts in the NICU & PICU, setting the stage for the subsequent implementation of the TRACHE care bundle.

The implementation phase involved introducing the educational program to the nurses in six groups. Each session, lasting 30 to 45

minutes, covered distinct topics through various teaching methods such as lectures, brainstorming, and small group discussions. The sessions were supported by teaching media, including presentations, posters, audiovisual materials, and handouts. Following each session, an informative brochure was distributed to each nurse to reinforce learning. The topics ranged from fundamental aspects of the TRACHE care bundle guild lines, Pediatric tracheostomy management safety. The implementation phase was meticulously executed three times a week over a specified time frame.

In the evaluation phase, post-implementation assessments were conducted to gauge changes in nurses' performance, at the NICU& PICU. Additionally, Pediatric tracheostomy management safety were evaluated, providing a comprehensive understanding of the impact of the TRACHE care bundle guild lines on both nursing practices and Pediatric tracheostomy management.

Ethical considerations:

Throughout this study, ethical issues were crucial. Nurses were approached after a thorough explanation of the study's purpose to gain their voluntary participation and explicit consent. In addition to individual consents, official approval from hospital administrative authorities in the defined context was meticulously secured, assuring respect to institutional norms and ethical standards. The ethical committee's approval further verified the study's ethical soundness. Recognizing the importance of secrecy and privacy, the data collection process was carried out with extreme care. The study emphasized the nurses' voluntary and anonymous engagement, ensuring that individuals may freely speak without fear of repercussions. Each nurse who took part in the study provided informed permission, confirming their comprehension of the study's objectives and their role in it. The study protocols were created with the participants' safety in mind, emphasizing the importance of their well-being. Furthermore, the ethical framework included the provision of professional support and counseling to participants when needed, emphasizing the commitment to the welfare and ethical treatment of the individuals involved in the study.

Statistical design

This study's statistical design comprises a detailed protocol for data input, validation, and analysis using the Statistical Package for the Social Sciences (SPSS) program, specifically version 21, with a significance threshold of 0.05. The data was rigorously checked before beginning the analyses to find and resolve any missing values. In terms of descriptive analysis, quantitative data were briefly summarized using mean and standard deviation, providing a complete understanding of the dataset's central tendency and variability. Categorical data, on the other hand, were presented as frequencies and percentages, providing a clear depiction of categorical variable distribution. The Chi-Square test was performed to assess the descriptive characteristics of the respondents, allowing for the identification of potential connections or discrepancies between categorical variables.

The effectiveness of the TRACHE care bundle guideline on both nurse performance and pediatric tracheostomy management were key part of the statistical design. This was performed by comparing the scores before and after the implementation of the TRACHE care bundle guidelines using an independent sample t-test. This statistical test enabled a thorough assessment of mean differences in scores, shedding light on the efficacy of the TRACHE care bundle guideline intervention. The study's specific objectives guided the selection of statistical tools and methods, which aimed to elucidate both the descriptive characteristics of the participants and the quantitative changes in nurses' performance and pediatric tracheostomy management as a result of the implementation of the TRACHE care bundle guidelines.

Results:

Table 1. depicts the socio-demographic characteristics of the nurses studied. According to the statistics, the majority of the nurses studied (69.6%) were between the ages of 20 and 30, with a mean age of 23.64.70. This table also reveals that 73.2 percent of the nurses evaluated were females. In terms of educational level, the table reveals that a Bachelor's degree was held by 42.9 percent of the nurses studied. In the survey, 44.6% of the nurses had less than 5 years of experience.. Finally, when asked about previous training in the tracheal nursing care bundle,

62.5% of the nurses interviewed stated they had none.

Table 2. Illustrates a detailed representation of the studied children socio-demographic characteristics in the Neonatal and Pediatric Intensive Care Units. This table reveals that more than the studied children (53.6%) their age were 5 years or more. Regarding gender 57.1 % of them were males. Finally, according to the length of stay in hospital, more than two thirds of the studied children (67.9%) reported to stay less than one month in the hospital,

Figure 1. Reveals total Knowledge of Studied Nurses Distribution regarding TRACHE care bundle guidelines at the pre and post-intervention levels. It displays the Nurses' total knowledge level before and after the intervention. This table reveals that there were major improvements in total knowledge level after the TRACHE Care Bundle Implementation compared to before, with nearly two-thirds (62.5%) reporting good knowledge in the post-phase, with statistically significant differences.

Table 3. Reports distribution of the Studied Nurses' Practice regarding TRACHE Care Bundle guideline at pre and post intervention. This table demonstrated that there were considerable changes in total practice level after TRACHE Care Bundle Implementation compared to before, with more than two-thirds (67.9%) reporting satisfactory practice in the post phase, with statistically significant differences with P. Value <0.001.

Table 4 shows the distribution of pediatric tracheostomy management safety assessments performed before and after intervention. The table indicated statistically

significant improvements in pediatric tracheostomy management safety after the TRACHE Care Bundle intervention, with a P value of 0.016.

Table 5. Illustrates association between nurses' socio-demographic and total studied nurses' knowledge at both before and after the intervention. The table demonstrated a statistically significant relationship between academic levels, experiences, and course training after TRACHE Care Bundle Implementation and total knowledge levels, with P values of 0.001, 0.021, and 0.001, respectively.

Table 6. Shows association between nurses' socio-demographic and total practice at pre and post intervention. The table revealed a statistically significant link between academic levels, experiences, and courses training in the post-TRACHE Care Bundle Implementation and overall practice levels, with P values of 0.001, 0.008, and 0.001, respectively.

Table 7. Reveals a relationship between total knowledge and total practice level of nurses before and after intervention the table indicated a statistically significant association with P. Value 0.001 between total practice level after TRACHE Care Bundle Implementation and total knowledge levels.

Table 8 depicts the relationship between pediatric tracheostomy management safety and studied nurses' TRACHE Care Bundle guideline practice during pre and post-intervention. The table revealed a statistically significant link with P. Value 0.001 between total tracheostomy management and examined nurses' Practice respecting TRACHE Care Bundle guidelines at post-intervention.

Table 1. The distribution of socio demographic variables of the nurses studied (N=56)

The socio-demographic characteristics of the nurses studied	N	%
Age (Years)		
Less than 20	13	23.2
20 – 30	39	69.6
30 or More	4	7.1
Mean ±SD	23.6 ±4.7	
Gender		
Male	15	26.8
Female	41	73.2
Academic Qualification		
Diploma degree	11	19.6
Associated degree	21	37.5
Bachelor degree	24	42.9
Experience in ICU (Years)		
Less than 5	25	44.6
5 – 10	22	39.3
More than 10	9	16.1
Mean ±SD	6.2 ±2.7	
Participating in prior tracheal nursing care bundle training		
Yes	21	37.5
No	35	62.5

Table 2. Distribution of the socio demographic characteristics of the studied children (n=28)

Socio demographic characteristics of the studied children	N	%
Age (Years)		
Less than 5 years	13	46.4
5-more years	15	53.6
Gender		
Male	16	57.1
Female	12	42.9
Duration of stay		
Less than one month	19	67.9
One month or more	9	32.1

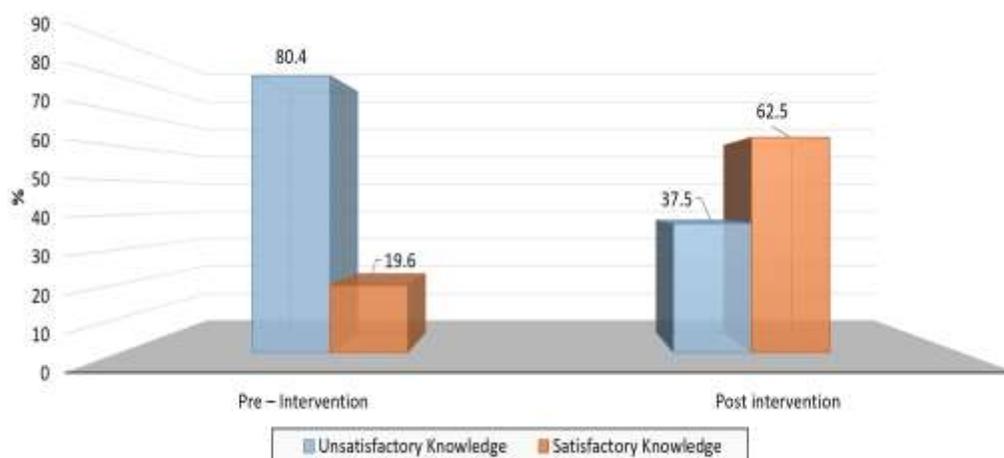
**Figure (1):** Distribution of the total knowledge of the studied nurses before and after the intervention concerning the TRACHE care bundle guideline (No=56)

Table 3. Distribution of the Studied Nurses' Practice regarding TRACHE Care Bundle at pre and post intervention (N=56)

TRACHE care bundle items	Pre – Intervention				Post intervention				Chi – Square	
	Inadequate Practice		Adequate Practice		Inadequate Practice		Adequate Practice		X ²	P
	N	%	N	%	N	%	N	%		
– Tapes – keep tube secure	31	55.4	25	44.6	13	23.2	43	76.8	12.128	<0.001**
– Resus – know the resuscitation process	37	66.1	19	33.9	20	35.7	36	64.3	10.325	<0.001**
– Airway clear – use correct suction technique	31	55.4	25	44.6	12	21.4	44	78.6	13.627	<0.001**
– Care of the site – stoma and neck	35	62.5	21	37.5	17	30.4	39	69.6	11.631	<0.001**
– Humidity – essential to keep the tube clear	33	58.9	23	41.1	19	33.9	37	66.1	7.036	0.008*
– Emergency box – always have the box present with the child	40	71.4	16	28.6	24	42.9	32	57.1	9.333	0.002*
Total Practice Level	36	64.3	20	35.7	18	32.1	38	67.9	11.586	<0.001**

Table 4. Distribution of pediatric tracheostomy management safety assessment at pre and post intervention (n=28)

Pediatric tracheostomy management safety	Pre – Intervention				Post intervention				Chi – Square	
	Unsatisfactory Practice		Satisfactory Practice		Unsatisfactory Practice		Satisfactory Practice		X ²	P
	n	%	n	%	n	%	n	%		
– Ensuring that the tracheostomy tube is secure, airway patency is maintained	16	57.1	12	42.9	8	28.6	20	71.4	4.667	0.031*
– Monitoring child's O2 saturation levels	18	64.3	10	35.7	8	28.6	20	71.4	7.179	0.007*
– Securing Velcro tapes that used to the tracheostomy tube	17	60.7	11	39.3	7	25.0	21	75.0	7.292	0.007*
Children checklist total level	17	60.7	11	39.3	8	28.6	20	71.4	5.853	0.016*

Table 5. Association between nurses' socio-demographic and total knowledge level at pre and post intervention (n=56)

Nurses' socio-demographic	Pre – Intervention						Post intervention					
	Unsatisfactory Knowledge		Satisfactory Knowledge		Chi – Square / Fisher's exact test		Unsatisfactory Knowledge		Satisfactory Knowledge		Chi – Square / Fisher's exact test	
	n	%	n	%	X ²	P	n	%	n	%	X ²	P
Age (Years)												
Less than 20	11	24.4	2	18.2			4	19.0	9	25.7		
20 – 30	31	68.9	8	72.7			17	81.0	22	62.9		
30 or More	3	6.7	1	9.1	0.241	0.887	0	0.0	4	11.4	3.268	0.195
Gender												
Male	13	28.9	2	18.2			6	28.6	9	25.7		
Female	32	71.1	9	81.8	0.517	0.472	15	71.4	26	74.3	0.055	0.815
Academic Qualification												
Diploma degree	9	20.0	2	18.2			11	52.4	0	0.0		
Associated degree	15	33.3	6	54.5			10	47.6	11	31.4		
Bachelor degree	21	46.7	3	27.3	1.851	0.396	0	0.0	24	68.6	33.651	<0.001**
Experience in ICU (Years)												
Less than 5	19	42.2	6	54.5			13	61.9	12	34.3		
5 – 10	18	40.0	4	36.4			8	38.1	14	40.0		
More than 10	8	17.8	1	9.1	0.745	0.689	0	0.0	9	25.7	7.655	0.021*
Attending previous training about tracheal nursing care bundle												
Yes	16	35.6	5	45.5			2	9.5	19	54.3		
No	29	64.4	6	54.5	0.370	0.543	19	90.5	16	45.7	11.220	<0.001**

Table 6. Association between nurses' socio-demographic and total practice at pre and post intervention (n=56)

Nurses' socio-demographic	Pre – Intervention						Post intervention					
	Unsatisfactory Practice		Satisfactory Practice		Chi – Square / Fisher's exact test		Unsatisfactory Practice		Satisfactory Practice		Chi – Square / Fisher's exact test	
	N	%	N	%	X ²	P	N	%	N	%	X ²	P
Age (Years)												
Less than 20	7	19.4	6	30.0			3	16.7	10	26.3		
20 – 30	28	77.8	11	55.0			15	83.3	24	63.2		
30 or More	1	2.8	3	15.0	4.264	0.119	0	0.0	4	10.5	3.099	0.212
Gender												
Male	10	27.8	5	25.0			4	22.2	11	28.9		
Female	26	72.2	15	75.0	0.051	0.822	14	77.8	27	71.1	0.282	0.596
Academic Qualification												
Diploma degree	8	22.2	3	15.0			11	61.1	0	0.0		
Associated degree	15	41.7	6	30.0			7	38.9	14	36.8		
Bachelor degree	13	36.1	11	55.0	1.878	0.391	0	0.0	24	63.2	34.604	<0.001**
Experience in ICU (Years)												
Less than 5	17	47.2	8	40.0			13	72.2	12	31.6		
5 – 10	12	33.3	10	50.0			5	27.8	17	44.7		
More than 10	7	19.4	2	10.0	1.773	0.412	0	0.0	9	23.7	9.677	0.008*
Attending previous training about tracheal nursing care bundle												
Yes	12	33.3	9	45.0			1	5.6	20	52.6		
No	24	66.7	11	55.0	0.747	0.388	17	94.4	18	47.4	11.549	<0.001**

Table 7. Association between nurses' total knowledge and total practice level at pre and post intervention (n=56)

Total knowledge	Pre – Intervention						Post intervention					
	Unsatisfactory Practice		Satisfactory Practice		Chi – Square / Fisher's exact test		Unsatisfactory Practice		Satisfactory Practice		Chi – Square / Fisher's exact test	
	n	%	n	%	X ²	P	n	%	n	%	X ²	P
Unsatisfactory Knowledge	29	64.4	7	63.6			14	66.7	4	11.4		
Satisfactory Knowledge	16	35.6	4	36.4	0.003	0.960	7	33.3	31	88.6	18.361	<0.001**

Table 8. Association between Pediatric tracheostomy management safety and studied nurses' Practice regarding TRACHE Care Bundle guideline at pre and post intervention

Pediatric tracheostomy management safety	Pre – Intervention						Post intervention					
	Unsatisfactory Practice		Satisfactory Practice		Chi – Square / Fisher's exact test		Unsatisfactory Practice		Satisfactory Practice		Chi – Square / Fisher's exact test	
	N	%	N	%	X ²	P	N	%	N	%	X ²	P
Unsatisfactory safety management	24	64.4	4	63.6			20	71.4	8	28.6		
Satisfactory safety management	17	60.7	11	39.3	0.011	0.850	8	28.6	20	71.4	11.45	<0.001**

Discussion

Tracheotomies 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 tracheotomies, there is substantial diversity in tracheostomy care across the country (Watters, 2017). Furthermore, there is no standardized training for healthcare personnel who give tracheostomy care on a regular basis. At the outset, healthcare personnel have varying levels of expertise about the function and care of tracheostomies (Zaga et al., 2023). Inadequate tracheostomy tube care can lead to secretion obstruction, which can cause sudden airway pain and, if left untreated, asphyxia death (Masood et al., 2018). In the current study, the impact of implementing the TRACHE care bundle on enhancing the safety of pediatric tracheostomy management in neonatal and paediatric intensive care units was assessed.

The Most research nurses had insufficient understanding of caring for a tracheostomy prior to program implementation, according to the study. Workload, insufficient competence,

being overloaded by more jobs, and working longer hours could all contribute to this. According to *Gaterega et al. (2021)*, the degree of knowledge on tracheostomy care among nurses was low, with only 46.4% correctly answering 7 questions. Only 2.5% of nurses had excellent knowledge of tracheostomy care, which differs with the findings of *Dhaliwal et al. (2018)*, who found that 43% of nurses had good knowledge. The study found that staff nurses lacked an understanding of tracheostomy care. According to *Khanum et al. (2021)*, the nurses who took the test demonstrated knowledge of tracheostomy care and maintenance.

According to the current study, 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. This finding was supported by *Mpasa et al. (2020)*. Who reported that following the educational intervention, both groups improved their awareness of nursing care techniques for managing endotracheal tube cuff pressure.

The knowledge and skills gap applies to noncritical care nurses as well as pediatric, critical care, anesthesia, and otolaryngology residents. *Zaga et al., (2020)* A lack of knowledge and expertise can lead to considerable patient morbidity and mortality as a result of airway obstruction. The current study found that the 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. As per *Gaterega et al. (2021)*, a mere 2.5 percent of the study sample exhibited a high degree of proficiency. Additionally, *Chen et al. (2021)* found discrepancies between the guidelines and the current practices of Chinese intensive care nurses, as well as a lack of knowledge on several crucial evidence-based endotracheal suctioning techniques. The current study indicates that following the implementation of the intervention, there was an improvement. *Azizian et al. (2020)* provided evidence for this conclusion (2020). who stated that there had been a discernible improvement in the endotracheal suctioning practice of nurses as measured by other metrics and the overall mean score.

Concerning the connection between the nurses' overall knowledge and their characteristics. The current study discovered a strong statistically significant correlation between the academic background, work experience, completion of preprogram implementation training and the overall knowledge level of nurses. This result was in line with that of *Dhaliwal et al. (2018)*, who found a strong correlation between knowledge and years of experience/work in the field. Moreover, there is no meaningful connection between education level and knowledge. The researchers interpret this to suggest that nurses' awareness and care-giving efficiency are influenced by their level of education.

Furthermore, the results of *Gaterega et al. (2021)*, who found no significant demographic variables associated with knowledge, were refuted by this conclusion. There was no statistically significant correlation found between the years of nursing experience, age, gender, qualification, or knowledge of

tracheostomy care in another study by *Khanum et al., (2021)* titled "Assessment of knowledge regarding tracheostomy care and management of early complications among healthcare professionals".

The current study found statistically significant correlations between the nurses' years of PICU experience, pre-intervention implementation courses, academic background, and their overall practice level. These associations pertain to the correlation between the attributes of nurses and their overall practice proficiency. In their study "Nurses' performance regarding the care of patients with tracheostomy," *Hussein et al. (2022)* discovered a significantly significant link between a nurse's total practice and years of experience. This result was consistent with what they had discovered.

However, this finding differs from that of *Dhaliwal et al. (2018)*, who discovered no significant association between tracheostomy care skills and age, gender, level of education, length of employment in the field, and completion of tracheostomy care education program. The study indicates that the number of years of PICU experience a nurse has an effect on how proficient they are with any given approach.

The results of this study showed a statistically significant positive correlation between the total practice level and the overall degree of knowledge held by nurses. This result was in line with the findings of *Dhaliwal et al. (2018)*, who used the Karl Pearson correlation formula to calculate a marginally favorable link between knowledge and abilities in tracheostomy care. The "Quality of Nursing Care on Patients with Tracheostomy" study by *El-Gawab (2017)* found a statistically significant positive correlation between total nurses' knowledge and total nurses' practice, which corroborated this finding.

Finally, following the study, there was a notable improvement in clinical skill competency, medical knowledge, and comfort level with normal and emergency tracheostomy care. This is attested to by notable gains in post-test results and post-course clinical skills assessments. Consequently, schooling had a positive effect on nursing performance for each

of them, enabling them to enhance their practices and knowledge. Keller, (2021) provides support for these findings. Who observed that a person's degree of education affects the learning process and that knowledge is more easily acquired by those with higher levels of education.

Conclusion

According to the current study, it successfully established the efficiency of a training program in improving nurses' knowledge and practices regarding the TRACHE Bundle guideline in the Neonatal and Pediatric Intensive Care Unit (NICU). The results demonstrated significant improvements in both knowledge scores and overall practices immediately following the intervention. The discovered positive link between knowledge and practice emphasizes the importance of a complete training approach that seamlessly blends academic concepts with practical clinical experience. These findings are consistent with prior literature, emphasizing the ongoing need for education in dynamic and critical care situations. In the future, continued intervention implementation and support will be critical for maintaining and improving nurses' performance in the TRACHEA bundle guideline intervention. Subsequent research may look into the long-term influence of such intervention on pediatric tracheostomy management safety.

Recommendations

The following suggestions can be considered in light of the study's findings:

1. A clinical nurse educator, who oversees the coordination of education and training for the intensive care nursing team, is a requirement for each critical care unit.
2. Every staff nurse who works in critical care needs to be prepared to make revisions. Enhance and broaden their knowledge and application of tracheostomy care.
3. compiled guidelines into a pamphlet for intensive care nurses regarding tracheostomy care.

The Further researcher

To increase the effectiveness of tracheostomy care provided by nurses, the educational training program must be implemented on a larger sample of nurses from various geographic regions of Egypt.

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