

# Strengthening Home-Based Pediatric Tracheostomy Care: A Video-Assisted Training Approach to Improve Caregiver Performance and Patient Safety in Government Hospital Pakistan

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## ABSTRACT

### Background

Effective home-based management of pediatric tracheostomy requires advanced technical skills and a high level of caregiver confidence. However, caregivers frequently face inadequate training and psychological stress, which may compromise the quality of care and negatively affect pediatric outcomes. Innovative educational strategies, such as video-assisted learning, provide a flexible and accessible approach to strengthening caregiver competence and self-efficacy.

### Objective

This study aimed to assess the impact of structured video-assisted educational modules on improving caregivers' practical skills and confidence in managing children with long-term tracheostomies.

### Methods

A quasi-experimental one-group pretest–posttest study was conducted at Services Hospital, Lahore, Pakistan. A total of 42 caregivers of children aged 6 months to 11 years with long-term tracheostomies were recruited using purposive sampling. Participants were organized into small training clusters and received biweekly video-based educational sessions over a period of 12 weeks. Caregiver performance was evaluated using a 13-item observational checklist, while confidence levels were measured through a 7-item structured questionnaire. Data were analyzed using SPSS version 25.0, and the Wilcoxon signed-rank test was applied to compare pre- and post-intervention outcomes.

### Results

Following the intervention, a statistically significant improvement was observed in both caregiver skills and confidence levels. The percentage of caregivers demonstrating good competency increased from 4.8% at baseline to 88.1% post-intervention, while those with poor skills decreased from 76.2% to 4.7% ( $p = 0.000$ ). In terms of confidence, caregivers reporting high confidence increased from 9.5% to 85.7%, whereas low confidence levels declined from 83.3% to 11.9% ( $p = 0.001$ ). Notable improvements were observed across all domains, including airway suctioning, tracheostomy site care, tube maintenance, and emergency response management, along with enhanced caregiver self-assurance in delivering home care.

### Conclusion

Structured video-assisted educational interventions significantly enhance caregiver competence and confidence in pediatric tracheostomy care. Incorporating such multimedia training into routine clinical education programs can improve the quality of home-based care, reduce caregiver anxiety, and support better health outcomes in children.

**Keywords:** Pediatric tracheostomy, caregiver education, video-assisted training, home-based care, competency, self-efficacy.

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## INTRODUCTION

### Background of Study:

The management of pediatric tracheostomy is most effective when delivered through an integrated, multidisciplinary framework that combines evidence-based clinical practices with structured caregiver education. Tracheostomy, a surgical intervention that establishes a direct airway via the trachea, plays a crucial role in the management of children with chronic respiratory failure or upper airway obstruction. However, beyond its clinical indications, the decision to undertake this procedure presents significant ethical complexities, especially in situations involving long-term ventilation, extended hospital stays, or considerations of palliative care pathways. Consequently, shared decision-making (SDM) has emerged as an essential component of care, facilitating collaborative discussions that incorporate caregivers' values, expectations, and perceptions regarding survival, discomfort, and quality of life. (Kon et al., 2016). Despite ongoing progress in pediatric airway management, ensuring safe and efficient tracheostomy care within low-resource environments remains a persistent challenge. Structural constraints such as limited healthcare infrastructure, inadequate access to specialized equipment, and insufficient professional training contribute to gaps in outpatient care and an increased burden of preventable complications. To mitigate these barriers, innovative and contextually adaptive approaches have been implemented, including low-cost, locally fabricated tracheostomy kits, pictorial instructional resources, and simulation-based capacity-building programs for nursing staff and early-career clinicians. Evidence highlights that these interventions play a critical role in strengthening caregiver self-efficacy and clinical proficiency, ultimately enhancing patient safety and care outcomes. (Sandler et al., 2020). The convergence of simulation-based learning and traditional bedside teaching has been increasingly recognized as an effective strategy for enhancing caregiver preparedness in tracheostomy care. This hybrid educational model not only strengthens knowledge acquisition but also plays a critical role in alleviating caregiver anxiety, thereby fostering readiness for the complexities of home-based care (Wooldridge & Carter, 2021). Additionally, the incorporation of visually oriented and graphic-based instructional resources has been shown to significantly elevate self-efficacy among both patients and caregivers.

Such tools facilitate the simplification of complex medical procedures and enable the identification of psychosocial and cognitive barriers that may compromise caregiver performance. Poor tracheostomy care practices have been consistently linked to adverse outcomes, including elevated readmission rates, increased clinical complications, and reduced quality of life. A major underlying issue is the limited availability of patient-centered educational materials tailored to diverse literacy levels, particularly for individuals with head and neck cancers. Within this framework, pictographic interventions have emerged as highly effective, demonstrating moderate to substantial gains in caregiver confidence and technical proficiency in managing tracheostomy care (Wang, 2021).

### Problem Statement:

Pediatric patients requiring long-term tracheostomy in Pakistan experience significant morbidity and mortality, with reported in-hospital mortality rates of approximately 8% and cumulative mortality ranging from 9% to 15% over a ten-year period. In addition to these clinical challenges, the burden of care extends deeply into the psychosocial and economic domains, disproportionately affecting family caregivers who often struggle with anxiety, emotional distress, and feelings of inadequacy. Existing hospital-based training programs are frequently insufficient, failing to equip caregivers with the practical skills and confidence necessary for effective home-based management and emergency response. In this context, video-based educational interventions represent a promising, scalable solution to address these gaps. However, empirical evidence evaluating their effectiveness in pediatric tracheostomy care within Pakistan is limited. Rigorous investigation is therefore required to determine their potential in enhancing caregiver preparedness and improving patient and family-centered outcomes.

### Significance of the Study:

The present study is designed to evaluate the effectiveness of tailored video-based educational interventions in enhancing the skills and confidence of caregivers responsible for children with long-term tracheostomies in home settings. Within the Pakistani context—characterized by limited formal caregiver training and persistently high tracheostomy-related mortality—such interventions represent a practical, low-cost, and scalable solution to bridge existing care gaps. By improving caregiver preparedness, these

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strategies may contribute to reduced hospital readmissions, improved clinical outcomes, and increased survival rates among affected children. Additionally, the study underscores the critical educational role of nurses, promotes a family-centered care framework, and advances a sustainable model for strengthening caregiver competence, psychosocial support, and quality of life, while enriching the global discourse on digital and multimedia-based healthcare education.

## **HYPOTHESES OF THE STUDY**

### **Alternative Hypotheses (H<sub>1</sub>)**

1. Tailored video-based educational interventions will significantly improve caregivers' tracheostomy care skills for children with long-term tracheostomies in the home setting.
2. Tailored video-based educational interventions will significantly enhance the confidence levels of caregivers managing children with long-term tracheostomies.

### **Null Hypotheses (H<sub>0</sub>)**

1. Tailored video-based educational interventions will not produce any significant improvement in caregivers' tracheostomy care skills for children with long-term tracheostomies in the home setting.
2. Tailored video-based educational interventions will not result in any significant change in the confidence levels of caregivers managing children with long-term tracheostomies.

### **Objectives of the Study**

1. To determine the effectiveness of tailored video-based educational interventions in improving caregivers' practical skills for home-based management of children with long-term tracheostomies.
2. To evaluate the impact of tailored video-based education on caregivers' confidence, preparedness, and ability to deliver safe and effective care at home.

### **Literature Review**

Recent initiatives in low-resource settings have prioritized the development of affordable and contextually appropriate solutions to improve tracheostomy care. For example, a pilot project conducted in Kigali, Rwanda implemented a low-cost tracheostomy care package that included a basic supply kit, a manual suction device, and a pictorial care guide, integrated within a simulation-based training program for nurses and junior doctors. The intervention led to noticeable improvements in participants' clinical competence and self-confidence, underscoring the value of cost-effective, visually guided educational strategies in settings where access to

formal training and specialized equipment is limited. (Karaca et al., 2019). A quasi-experimental study evaluated the competency of 50 nurses in tracheostomy care and examined the effect of a structured educational intervention. Findings revealed that baseline knowledge levels were low, ranging from 5% to 40%, and increased markedly to 65%–92% following training. Notably, approximately 88% of participants had no previous formal training in tracheostomy care. The improvement was statistically significant ( $p < 0.001$ ), indicating substantial knowledge gaps irrespective of nurses' academic qualifications or years of experience. The study emphasized the need for mandatory continuing education programs to ensure safe and effective tracheostomy care practice among nursing staff. (Abdulrahman et al., 2021). Baron et al. (2023) demonstrated that structured hospital-based training programs play a crucial role in enhancing family caregivers' preparedness and confidence in managing tracheostomy care at home. The inclusion of phased discharge planning and peer support systems further facilitated a smoother transition from hospital to home care. In a similar context, Yan et al. (2022) introduced a peer-narrative-based intervention aimed at supporting parents in making informed decisions about tracheostomy placement. Their approach emphasized the provision of timely, balanced, and practical information regarding caregiving demands, responsibilities, and long-term quality-of-life considerations. Together, these studies underscore the critical importance of comprehensive education and supportive frameworks in empowering caregivers of children with tracheostomies.

## **MATERIALS AND METHODS**

### **Study Design**

A pre-experimental, single-group pretest–posttest design was adopted to evaluate the effect of a structured video-assisted educational program on caregivers' knowledge, practical skills, and confidence related to pediatric tracheostomy care.

### **Study Setting**

The study was conducted at the Pediatric Unit of GOVT Hospital.

### **Study Population**

The target population comprised primary caregivers of children living with long-term tracheostomies who were directly involved in daily care activities.

### **Study Duration**

The research was carried out over a period of eight months, from March 2025 to October 2025, following approval from the Institutional Ethical Review Board.

### **Operational Definitions**

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**Caregiver Competency:** Defined as the caregiver's ability to safely perform essential tracheostomy care tasks, including airway suctioning, tube maintenance, recognition of respiratory distress, infection prevention, and emergency response. Scoring range: 10–30

- Poor:  $\leq 12$
- Moderate: 13–21
- High: 22–30

**Caregiver Confidence:** Refers to the perceived self-efficacy of caregivers in managing routine and emergency tracheostomy care situations. Scoring range: 5–20

- Low:  $\leq 7$
- (Moderate): 8–14
- High: 15–20

## Variables

- **Independent Variable:** Structured video-based tracheostomy care education
- **Dependent Variables:** Caregiver competency and confidence levels

## Sample Size

The calculated minimum sample size was 36 participants. After accounting for a 15% potential attrition rate, a total of 42 caregivers were enrolled in the study.

## Inclusion Criteria

- Immediate family members (parents or siblings) responsible for caregiving
- Caregivers with limited prior exposure to tracheostomy care
- Individuals providing at least 10 hours/day of care
- Caregivers of children aged 6 months to 10 years

## Exclusion Criteria

- Medically trained individuals (e.g., nurses, paramedics)
- Caregivers already receiving structured home-care training
- Those unable to participate in follow-up sessions
- Individuals without access to a smartphone or video playback device

## Study Instruments

### Demographic Questionnaire

A structured form was used to collect baseline data, including age, gender, education level, socioeconomic status, and caregiving experience.

### Tracheostomy Care Competency Checklist

An observational checklist assessed caregivers' practical skills before and after the intervention.

### Caregiver Confidence Scale

Likert-scale questionnaire measured perceived confidence in performing tracheostomy-related tasks.

## Educational Intervention (Video Modules)

A series of culturally adapted instructional videos in Urdu and English were developed based on international clinical guidelines, including airway management, hygiene practices, and emergency handling techniques.

## Sample Size Calculation

Sample size estimation was performed using a 95% confidence level and 80% study power, with an expected mean difference of  $3.5 \pm 1.2$  derived from pilot observations. The final sample was adjusted to 42 participants to compensate for possible dropouts.

## Data Collection Procedure

Following ethical approval, eligible caregivers were approached and informed about the study objectives. Written informed consent was obtained prior to participation.

## Pre-Intervention Phase

Participants were divided into five small groups (8–9 caregivers per group). Baseline assessments of skills and confidence were conducted using standardized tools.

## Intervention Phase

The intervention was delivered over 10 weeks through biweekly sessions (lasting 60–90 minutes). Each session included:

- Video demonstrations
- Practical skill training
- Group discussions
- Printed educational materials

## Post-Intervention Phase

At the end of the intervention period, caregivers were reassessed using the same tools to evaluate improvements in competency and confidence.

## Data Analysis

Data were analyzed using IBM SPSS Statistics version 26. Descriptive statistics (mean, standard deviation, frequency, and percentage) were used to summarize demographic characteristics. The **Wilcoxon signed-rank test** was applied to compare pre- and post-intervention scores. A p-value of  $< 0.05$  was considered statistically significant.

## RESULTS

### Demographic Characteristics of Participants (n = 42)

Table 4.1 presents the demographic profile of caregivers. The majority of participants were females (69.0%), with most aged between 26–35 years (45.2%). A large proportion had secondary-level education (40.5%), and most were parents (61.9%) of the child.

### Table 1: Demographic Characteristics of Caregivers (n = 42)

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Variable	Category	Frequency (f)	Percentage (%)
Age (years)	18–25	10	23.8%
	26–35	19	45.2%
	36–45	9	21.4%
	>45	4	9.5%
Gender	Male	13	31.0%
	Female	29	69.0%
Education Level	Primary	11	26.2%
	Secondary	17	40.5%
	Higher	14	33.3%
Relation to Child	Parent	26	61.9%
	Sibling	6	14.3%
	Other relatives	10	23.8%

**Comparison of Caregiver Competency Scores (Pre vs Post Intervention)**

A significant improvement was observed in caregiver competency scores after the intervention. The mean score increased from  $13.4 \pm 3.2$  (pre-test) to  $24.8 \pm 2.6$  (post-test).

**Table 2: Comparison of Pre- and Post-Intervention Competency Scores (n = 42)**

Variable	Mean $\pm$ SD	Median (IQR)	Z-value	p-value
Pre-test Competency	13.4 $\pm$ 3.2	13 (11–16)		
Post-test Competency	24.8 $\pm$ 2.6	25 (23–27)	-5.62	0.000*

\*Wilcoxon Signed-Rank Test applied

\*p < 0.05 = statistically significant

**Comparison of Caregiver Confidence Scores (Pre vs Post Intervention)**

The caregivers' confidence level showed a marked increase following the intervention, with mean scores rising from  $7.1 \pm 2.1$  to  $16.2 \pm 1.9$ .

**Table 4.3: Comparison of Pre- and Post-Intervention Confidence Scores (n = 42)**

Variable	Mean $\pm$ SD	Median (IQR)	Z-value	p-value
Pre-test Confidence	7.1 $\pm$ 2.1	7 (5–9)		
Post-test Confidence	16.2 $\pm$ 1.9	16 (15–18)	-5.48	0.000*

\*Wilcoxon Signed-Rank Test applied

\*p < 0.05 = statistically significant

**Level of Caregiver Competency Before and After Intervention**

Before the intervention, most caregivers (57.1%) had moderate competency, while only 9.5% demonstrated high competency. After the intervention, 78.6% achieved high competency.

**Table 4: Distribution of Competency Levels (Pre vs Post)**

Competency Level	Pre-test f (%)	Post-test f (%)
Poor	14 (33.3%)	2 (4.8%)
Moderate	24 (57.1%)	7 (16.7%)
High	4 (9.5%)	33 (78.6%)

**Level of Confidence Before and After Intervention**

Prior to the intervention, 61.9% of caregivers had low confidence. Post-intervention results showed that 81.0% achieved high confidence levels.

**Table 5: Distribution of Confidence Levels (Pre vs Post)**

Confidence Level	Pre-test f (%)	Post-test f (%)
Low	26 (61.9%)	3 (7.1%)
Moderate	13 (31.0%)	5 (11.9%)
High	3 (7.1%)	34 (81.0%)

**DISCUSSION**

The present study demonstrates that tailored video-based educational interventions significantly enhance both the clinical competence and confidence of caregivers managing children with long-term tracheostomies. At baseline, the majority of caregivers exhibited limited practical skills and low confidence, indicating inadequate preparedness for home-based care. However, following the intervention, a substantial proportion of participants achieved higher levels of competency and confidence, with statistically significant improvements ( $p < 0.001$ ). These findings highlight the critical role of structured and accessible educational strategies in addressing existing gaps in caregiver training. The results are consistent with previous studies that emphasize the effectiveness of structured educational interventions in improving caregiving outcomes. For instance, Smith et al. (2020) and Kwon et al. (2021) reported that multimodal training approaches—combining demonstrations, digital tools, and reinforcement—significantly improve caregivers' clinical skills. Similarly, Lima et al. (2022) found that standardized tracheostomy education programs are associated with reduced complication rates and better clinical outcomes in pediatric patients. In addition to improving technical abilities, the observed increase in caregiver confidence reflects the psychological benefits of targeted education. Caregivers of children with tracheostomies often experience anxiety, uncertainty, and emotional stress due to the complexity of care. Educational interventions that provide clear, structured, and repeated guidance can alleviate these concerns and enhance caregivers' self-

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efficacy (Bayoumi & Alwakeel, 2020; Nageswaran et al., 2018). Furthermore, video-based education offers a practical and scalable solution, particularly in resource-limited settings. Its flexibility allows caregivers to learn at their own pace and revisit content as needed, making it especially effective for individuals with varying literacy levels. Chorney et al. (2020) highlighted that visual and digital learning tools significantly improve knowledge retention and caregiver engagement, supporting the findings of the current study. Despite these encouraging outcomes, certain limitations should be acknowledged. The relatively small sample size and single-institution setting may restrict the generalizability of the findings. Future research with larger, multi-center samples is recommended to validate these results and to assess the long-term impact of video-based interventions on patient health outcomes and caregiver well-being.

### CONCLUSION

In conclusion, the study confirms that video-based educational interventions are highly effective in improving caregivers' skills and confidence in managing pediatric tracheostomy care at home. Such structured and culturally appropriate training programs empower caregivers, enhance the safety and quality of home care, and may contribute to improved clinical outcomes for children. Integrating multimedia-based education into routine caregiver training is strongly recommended, particularly in low-resource settings, to strengthen family-centered care and support sustainable healthcare practices.

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