Featured Article

Tracheostomy Overlay System: An Effective Learning Device Using Standardized Patients

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Abstract: A team of students and faculty from engineering and nursing developed a wearable Tracheostomy Overlay System (TOS) for use with standardized patients. This device was designed to improve education of health professions students while learning assessment and care of a patient with a tracheostomy in clinical practice. The initial study of the TOS included nursing student participants (N = 57) who were tested on tracheostomy care and suctioning using either the traditional teaching method (a manikin) or the new TOS on a standardized patient to determine effectiveness of the TOS as a teaching method. Self-efficacy surveys were collected and identified clinical behavior was observed and quantified by two trained, independent observers. Survey results indicated significantly more positive clinical interaction (19.7 ± 8.34 TOS vs. 4.0 ± 4.80 manikin, $p < .05$) and self-correction (3.04 ± 1.95 TOS vs. 0.43 ± 0.73 manikin, $p < .05$) when the participants used the TOS. The TOS has the potential to improve simulated nursing education in both academia and clinical practice settings for patients with a tracheotomy.

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The Tracheostomy Overlay System (TOS) is a wearable chest plate for standardized patients (SPs) that can be used in skills and simulation education. The current use of SPs in simulation is proven to be an effective way to increase fidelity; however, there are many limitations on the type of injury or illness that can be assigned to SP cases. When using SPs, complex cases that require invasive lines and tubes, such as a tracheostomy tube, are not currently feasible, and although high-fidelity (HF) manikins have this capability, they lack the necessary human interaction and feedback that SPs offer to simulation. The TOS has been developed and evaluated by an interdisciplinary team of faculty and students from three departments (engineering, nursing, and theatre) to address the limitations of the SPs in simulation. The device sits over the actor's torso,

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aesthetically representing a chest and throat with an inserted tracheostomy tube. Nursing students can now perform tracheostomy care and suctioning on a live patient and perform an assessment, tracheostomy care, and suctioning while the actor reacts appropriately to deep suctioning or too much faceplate pressure/manipulation using cues built into the device. Additionally, this device can be used for scenario-based simulations that are designed for patients with a tracheostomy.

> **Key Points**
> - SPs are an effective healthcare education tool but are limited to non-invasive procedures.
> - Tracheostomy care and suctioning is important to healthcare training, but requires an invasive procedure, preventing the use of SPs in training.
> - The TOS allows SPs to be used in tracheostomy care and suctioning training.

Background

A tracheostomy is a surgically created artificial airway that enters through the anterior aspect of the neck into the trachea to bypass the upper airway and provides a safe airway to a patient whose airway is otherwise obstructed (Dawson, 2014). This procedure is one of the oldest and most common medical procedures for life-threatening airway obstructions (Rajesh & Meher, 2005). The most common reason for a tracheostomy is for long-term mechanical ventilation; however, the procedure is also used when there is severe upper airway obstruction due to trauma, anaphylactic reaction, and infection (Dawson, 2014).

Tracheostomy care consists of sustaining the surgically inserted tracheostomy tube and stoma to reduce bacterial growth and preventing infection, as well as preventing skin breakdown and contain secretions so they do not block the tube (Craven & Hirnle, 2000; Nance-Floyd, 2011). Nurses are primarily responsible for tracheostomy care, including the cleaning, replacing, or changing the inner cannula, changing the dressing, and cleaning the area around the stoma (Craven & Hirnle, 2000). All these procedures require minor disturbances of the face plate (Dawson, 2014). For tracheostomy care and suctioning, nursing students are learning their psychomotor skills during practice simulations (Lasater, 2007); therefore, it is important to reinforce the need to stabilize the face plate when the inner cannula is removed.

Another important factor in tracheostomy care is the comfort of the patient. Patients report discomfort when more pressure is placed on their trachea. Verbal communication of the patient is impaired during the tracheostomy cleaning procedure; therefore, nursing students must use alternative methods to determine when they are causing discomfort to the patient (Dawson, 2014; Serra, 2000). Improper patient care can result in trauma to the trachea, impaired oxygenation, decannulation, infection, and airway occlusion (Mitchell et al., 2012; Nance-Floyd, 2011).

Patients with tracheostomy tubes often require tracheal suctioning to maintain a clear airway or improve ventilation by removing excess secretions (Dawson, 2014; Martin, 2008; Mitchell et al., 2012). There is great variation on the suctioning technique used among clinicians (Mitchell et al., 2012; Nance-Floyd, 2011). Although suctioning is a skill that can be lifesaving, it also poses a threat to the patient through complications, including hypoxemia, mucosal trauma, increased intracranial pressure, infection, atelectasis, and cardiac arrhythmias (Martin, 2008). These threats are exacerbated with poor technique and uninformed care providers. The use of deep suctioning has been discouraged in the literature secondary to mucosal trauma at the carina (Bailey, Kattwinkel, Teja, & Buckley, 1988; Nagaraj, Fellows, Shott, & Yacoub, 1980). Bailey et al. (1988) reported that significant necrosis or tracheal inflammation can be the result of the suction catheter impacting the patient's carina. Nagaraj et al. (1980) reported that repeated impact caused by deep suctioning also leads to formation of granulation tissue and bronchial stenosis. Patients with tracheostomy tubes already lack the body's natural filtration of the upper airway which makes them more susceptible to infection (Dawson, 2014). Respiratory infections can be deadly to patients who are already medically fragile, making it imperative for nurses to have the proper training before practicing these skills in a clinical setting.

Teaching methods for nursing students may involve practice on static or HF manikins. The static manikin is anatomically correct and gives the ability to physically practice tracheostomy care and suctioning (Lasater, 2007; McCaughey & Traynor, 2010). HF manikins offer scenario-based simulations and can be standardized as well as easily modified to simulate any number of clinical scenarios (Lasater, 2007; Triola et al., 2006). Training with HF manikins has been found to enhance patient safety, as well as improve fidelity to hospital settings according to participants (McCaughey & Traynor, 2010).

However, there are limitations with manikins. The static manikins are unable to provide realistic patient reactions or real-time feedback (Berragan, 2011; Luctkar-Flude, Wilson-Keates, & Larocque, 2012; McCaughey & Traynor, 2010). Although the HF manikins are equipped with speakers that can be used during a simulation to answer participant questions, there is no ability for the health care participants to use nonverbal cues from the patient to improve their communication and react to a realistic physical response (Lasater, 2007). Additionally, the cost of HF manikins as well as the staff to maintain them is often unaffordable for many colleges and universities (Lasater, 2007). The difficulty in creating a realistic environment in current simulations may lead to difficulties when translating patient care in practice (Berragan, 2011). The lack of realistic experience can lead to procedural errors, create distrust in patients, and impede the nurse−patient relationship.