**Supplementary Materials**

**Supplementary Figure Legends**

**Fig. S1.** Three-dimensional model displayed in the Magics 3D preparation software (Materialise).

**Fig. S2.** CONSORT flow diagram.

**Table S1 Direct Observation of Procedural Skills**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Assessment** | **Below expectations** |  | **Met expectations** |  | **Above expectations** |
|  | **1** | **2** | **3** |  | **4** | **5** | **6** |  | **7** | **8** | **9** |
| 1. **Preparation before the procedure**
 |  |  |  |  |  |  |  |  |  |  |  |
| 1. Explains to the patient
 |  |  |  |  |  |  |  |  |  |  |  |
| 1. Prepares items for use
 |  |  |  |  |  |  |  |  |  |  |  |
| 1. **Executing the procedure**
 |  |  |  |  |  |  |  |  |  |  |  |
| 1. Washes hands
 |  |  |  |  |  |  |  |  |  |  |  |
| 1. Administers 100% oxygen before suctioning sputum
 |  |  |  |  |  |  |  |  |  |  |  |
| 1. Turns on the suction machine and verifies the vacuum pressure, which should be 100–150 mmHg for adults
 |  |  |  |  |  |  |  |  |  |  |  |
| 1. Opens the suction catheter packet with aseptic techniques
 |  |  |  |  |  |  |  |  |  |  |  |
| 1. Puts on sterile gloves
 |  |  |  |  |  |  |  |  |  |  |  |
| 1. Uses aseptic techniques to remove the suction catheter and attaches the suction machine tubing
 |  |  |  |  |  |  |  |  |  |  |  |
| 1. Disconnects the ventilator and gently inserts the suction catheter to an appropriate position in the endotracheal tube. Does not press the control valve
 |  |  |  |  |  |  |  |  |  |  |  |
| 1. Uses a rotating motion to intermittently suction with the suction catheter
 |  |  |  |  |  |  |  |  |  |  |  |
| 1. Suctioning procedure does not exceed 15 seconds
 |  |  |  |  |  |  |  |  |  |  |  |
| 1. When suctioning is complete, reattaches the artificial airway to the ventilator, clears the suction machine tubing, and turns off the suction machine
 |  |  |  |  |  |  |  |  |  |  |  |
| 1. Removes gloves, wraps the suction catheter, and discards it in a bin for burnable infectious waste
 |  |  |  |  |  |  |  |  |  |  |  |
| 1. **Assessment and hand hygiene**
 |  |  |  |  |  |  |  |  |  |  |  |
| 1. Observes respiratory pattern and vital signs
 |  |  |  |  |  |  |  |  |  |  |  |
| 1. Assesses sputum
 |  |  |  |  |  |  |  |  |  |  |  |
| 1. Washes hands
 |  |  |  |  |  |  |  |  |  |  |  |

**Table S2 Written Examination**

|  |  |  |
| --- | --- | --- |
| **Question** | **Answers** |  |
| 1. What is the purpose of suctioning sputum?
 | 1. To help treat a cold
 |  |
| 1. To maintain airway patency
 | V |
| 1. To prevent disease
 |  |
| 1. To stimulate breathing
 |  |
| 1. What is the correct sequence for suctioning phlegm? a) Wash your hands, b) Turn on the suction machine, c) Put on sterile gloves, d) take out and insert the suction catheter, e) Suction the sputum, f) Turn off the suction machine, g) Remove sterile gloves, h) Discard the suction catheter, i) Discard the suction machine, j) Open the suction catheter packet
 | 1. a→b→j→c→d→e→f→g→h→a
 | V |
| 1. a→c→b→e→f→i→g→a
 |  |
| 1. a→j→c→e→h→f→g→a
 |  |
| 1. a→c→j→e→g→f→h→a
 |  |
| 1. During the process of suctioning phlegm, if the patient experiences difficulty breathing, which of the following is an inappropriate course of action?
 | 1. Immediately stopping the suctioning process
 |  |
| 1. Assisting the patient in adopting proper breathing techniques to maintain adequate blood oxygenation
 |  |
| 1. Administering an appropriate amount of oral fluids to alleviate breathing difficulties
 | V |
| 1. Maintain a patent airway and provide tracheal intubation or oxygen therapy as indicated
 |  |
| 1. When suctioning phlegm from an artificial airway by using a suction catheter, what is the maximum duration for which the catheter can remain inserted?
 | 1. 5 seconds
 |  |
| 1. 15 seconds
 | V |
| 1. 30 seconds
 |  |
| 1. 60 seconds
 |  |
| 1. When suctioning phlegm from an artificial airway, what is the maximum suction pressure in mmHg that should be applied for adults?
 | 1. 80 mmHg
 |  |
| 1. 100 mmHg
 |  |
| 1. 150 mmHg
 | V |
| 1. 300 mmHg
 |  |

**Table S3 Satisfaction Questionnaire**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Items** | **Strongly disagree** | **Disagree** | **Neutral** | **Agree** | **Strongly agree** |
| 1. After being taught and demonstrated the skills by the teacher, I had a clear understanding of the learning objectives.
 |  |  |  |  |  |
| 1. After being taught and demonstrated the skills by the teacher, I had a clear understanding of the practical operations.
 |  |  |  |  |  |
| 1. After being taught and demonstrated the skills by the teacher, I clearly understood problem-solving and troubleshooting related to the practical operations.
 |  |  |  |  |  |
| 1. After being taught and demonstrated the skills by the teacher, my learning focus was enhanced.
 |  |  |  |  |  |
| 1. After being taught and demonstrated the skills by the teacher, my level of participation in learning was higher.
 |  |  |  |  |  |
| 1. After being taught and demonstrated the skills by the teacher, my interest in learning was increased.
 |  |  |  |  |  |
| 1. After being taught and demonstrated the skills by the teacher, my willingness to learn actively was higher.
 |  |  |  |  |  |
| 1. After being taught and demonstrated the skills by the teacher, I could master this technique.
 |  |  |  |  |  |
| 1. I think the teacher taught and demonstrated the skills clearly.
 |  |  |  |  |  |
| 1. The teaching time was sufficient.
 |  |  |  |  |  |
| 1. After being taught and demonstrated the skills by the teacher, I think my practice time was sufficient.
 |  |  |  |  |  |
| 1. I like this teaching method.
 |  |  |  |  |  |