Using In Situ Simulation to Develop a Prone Positioning Protocol for Patients With ARDS

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**Background**
Acute respiratory distress syndrome carries a 40% mortality rate. Prone positioning remains underused owing to clinicians’ low degree of confidence, concern about the risk of adverse outcomes, and lack of staff competency training.

**Local Problem and Purpose**
A prone positioning protocol and educational program were needed in an intensive care unit to achieve compliance with best practices for treating acute respiratory distress syndrome patients.

**Methods**
An initial survey was conducted to measure staff confidence and competency in prone positioning. A literature review was performed, and a plan-do-study-act approach was used to develop a protocol through in situ simulation involving mock patients. A training video and a simulation scenario using a high-fidelity manikin were developed to facilitate staff education. Staff were surveyed again after training.

**Interventions**
During the simulation scenario, interdisciplinary clinicians learned to apply the protocol and resupinate the patient during a simulated emergency. The training video was later used for “just in time” education minutes before actual prone positioning events.

**Results**
A total of 25 critical care nurses, 11 respiratory therapists, and 10 physicians completed the initial survey and simulation training. The survey showed that staff lacked confidence and competency in prone positioning. Staff demonstrated competence during the simulation sessions, and posttraining surveys indicated increased confidence. After the educational program, prone positioning was successfully used for 6 critically ill acute respiratory distress syndrome patients.

**Conclusions**
In situ simulation and interdisciplinary collaboration increase standardization of high-risk, underused procedures, improving staff confidence and competence as well as patient safety. (Critical Care Nurse. 2021;41[1]:12-24)
Acute respiratory distress syndrome (ARDS) continues to be a life-threatening condition, with mortality rates of up to 40% in critically ill patients. Acute respiratory distress syndrome results from a primary lung insult and is associated with a variety of diagnoses including sepsis, pneumonia, and trauma. The initial lung insult is followed by diffuse inflammation, alveolar flooding, and damage. The injury leads to a ventilation-perfusion mismatch and hypoxemia. The standard mechanical ventilatory support for ARDS involves low tidal volume ventilation. Severe cases may require additional evidence-lacking therapies such as therapeutic paralysis, inhaled vasodilators, and extracorporeal membrane oxygenation. Prone positioning, in use since the 1970s, has been shown to decrease mortality in patients with severe ARDS.

With the body in the supine position, lung tissue is susceptible to compression by the heart and other abdominal viscera in the thoracic cavity as well as by shape mismatching of the chest wall and diaphragm with respect to gravitational forces. In ARDS, the fluid-overloaded lung becomes heavy and edematous, thereby further increasing the normally high dorsal pleural pressures compared with the ventral pleural pressures. In this situation the ventral alveoli become overinflated and the dorsal alveoli become further compressed. The prone or face-down position allows for less difference between the dorsal and ventral transpulmonary pressures, making oxygenation and ventilation more homogeneous. Prone position ventilation allows for the recruitment of the otherwise collapsed dorsal alveoli, thus improving oxygenation.

The Proning Severe ARDS Patients (PROSEVA) trial, published in 2013, demonstrated a decrease in mortality by up to 16% for patients in the prone position compared with controls. The trial included 466 ARDS patients in 27 intensive care units (ICUs) across Europe. As a result of the findings in the PROSEVA study, researchers have suggested that prone positioning be considered as a first-line treatment approach for ARDS rather than a salvage therapy. However, prone positioning remains underused in ARDS patients owing to a variety of identified barriers, including lack of confidence in performing the maneuver, lack of staff competency due to absence of formal policies or training, and concerns about possible complications resulting from providing nursing care to patients in the prone position.

Prone positioning is regarded as a high-risk procedure, with possible adverse outcomes including loss of airway, loss of central catheters and peripheral intravenous access, and pressure injury of the anterior surface of the body, including the face. If cardiac arrest occurs in a critically ill patient in the prone position, the outcome may be disastrous in the absence of properly trained staff. Cardiopulmonary resuscitation (CPR) is the key to survival for patients in cardiac arrest, and prone positioning can lead to a delay in initiation of CPR as the team decides how to resupinate the patient. In addition, resupination of a patient during an emergency carries a higher risk of dislodgment of the airway and loss of essential vascular accesses as the urgency of the situation reduces attention to safe and careful repositioning. These potential adverse outcomes indicate the need for a solid protocol for prone positioning carried out by competent and skilled professionals.

Problem
Our 24-bed ICU that serves medical, surgical, and trauma patients in an inner-city environment did not have an established systemwide prone positioning protocol. Before protocol development, the assistant nursing care coordinator (ANCC; J.M.), who also serves as the nursing clinical leader of the unit with the medical director of the ICU, performed a needs assessment of the clinical ICU staff, including ICU physicians, nurses, and respiratory therapists, by polling their knowledge.
experience, and perceived barriers on the use of prone ventilation for ARDS. Feedback was variable. Physicians reported the highest use and knowledge of prone positioning. Of 49 ICU nurses polled, half (with the exception of 2 assistant nursing care coordinators) were unfamiliar with how to perform the maneuver and could not cite its benefits or the mechanism by which it improved oxygenation. All nurses questioned voiced concerns related to having appropriate staffing to perform the maneuver and provide acute management in an emergency, loss of airway and vascular access, ability to perform key nursing actions, and lack of training. Results from this survey helped identify areas in which staff education was needed and served as a baseline for knowledge and skills development after implementation of the prone positioning protocol.

Specific Aims
Feedback from the needs assessment led to the decision to develop a policy and a protocol for prone positional ventilation and provide formal training in the procedure. This article describes the process that was undertaken by an interdisciplinary critical care team to create an evidence-based, step-by-step protocol for manual prone positioning, using in situ simulation for protocol development.

Methods
Context
A work group of physicians, critical care nurses, and respiratory therapists was formed and conducted an extensive literature review of best evidence-based practices for prone positioning, including necessary orders, required length of time for the position to be effective, and interventions to reduce the risk of adverse outcomes.1,13

Prone positioning can be accomplished in several ways: manually (using the physical labor of staff), automatically (using a rotating proning bed), and with or without the use of assistive devices to complete the process. The literature does not support a single modality as universal best practice for achieving prone positioning. Rather, each individual facility determines which method would best meet the needs of its patients, staff, and institution. Factors that contribute to this decision are facility resources, staff skill set, supportive resources, and access to specialized equipment.21 Manual prone positioning was chosen as the preferred method for our unit and institution. The exorbitant cost of proning beds played a small role in this decision. The primary reasons for choosing a manual prone positioning protocol were its uncomplicated technique using simple linens (1 flat sheet), the ability to complete the maneuver using the physical labor of staff, and its provision of better access to the patient for nursing care in emergency situations. A drawback of manual prone positioning versus use of an automated proning bed is that the clinicians tasked with carrying out the maneuver must be experienced and highly skilled to address any adverse events that might occur.17 This need was addressed by choosing in situ simulation for protocol development and safe testing of staff members’ ability to carry out each step of the process and formal simulation training after completion of protocol development to prepare staff and support their long-term educational needs. In situ simulation (a style of team training that practices a simulated real-world scenario while eliminating actual patient risk) was selected to improve reliability and safety of this high-risk underused procedure. In situ simulation has been shown to be a safe way to test changes of medical practices for feasibility while avoiding patient harm before implementation.22,23

The plan-do-study-act method was chosen to test the change in knowledge and practice. The protocol was designed to provide a stepwise process that staff members could follow to place a critically ill patient in the prone position.

Interventions
Development and Testing of the Protocol.
In situ simulation was used for protocol development to provide a safe, supervised setting that did not pose risks of harm to actual ARDS patients. A mock patient was used in place of a manikin to create clinical realism and provide valuable experiential learning. Preparation of the mock patient involved taping endotracheal tubes, venous and arterial catheters, and urinary catheters to the individual to simulate the actual clinical condition. Each in situ simulation included a team of ICU staff who were given specific roles: 5 to 6 nurses (4 to turn, 1 to
protect all vascular and arterial accesses, and 1 as the nurse leader), 3 to 4 physicians (1 as the physician leader and 1 to 2 for turning and additional emergency support), 2 respiratory therapists (1 to protect the endotracheal tube and 1 to reposition the head during the maneuver), and members of the core interdisciplinary work group. Real-time feedback from the team allowed the work group to amend and improve the protocol (Figures 1 and 2). During the simulation process, a nursing checklist was developed that included steps to prepare the patient and the room before the prone positioning event (see Table). These steps were broken down into categories: equipment needed for room and patient preparation; orders needed before, during, and after prone positioning; and tasks to complete before and after positioning. Finally, a step-by-step narrative was added for the nurse leader to use while directing the maneuver.

Achieving situational awareness was incorporated as a major step in the protocol to promote formal communication to all staff members assigned to the unit (including nursing attendants, unit secretaries, and all physicians), ensuring the availability of backup assistance if needed. The physician informs the family of the need for the prone position, describing its benefits and noting that the patient will be positioned facedown for up to 16 hours. Adequate education of the family is important to prepare them for what to expect and helps alleviate distress.

**Refinement of the Protocol.** By the third in situ simulation, the prone positioning protocol was finalized, with all updates and revisions based on experience and feedback incorporated. Participants in the third in situ simulation reported comfort with the checklist organization and flow, room and patient setup, equipment, orders, and step-by-step maneuvers. A 7-minute high-definition video of an in situ simulation was produced as an additional training tool for critical care staff, which was intended to be used in annual competency assessments. The prone
positioning policy, protocol, checklist, and video were presented to the hospital’s nursing executive committee for approval for official hospital use and then uploaded to the hospital’s intranet.

**Team Training.** We partnered with the hospital’s simulation center to plan formal training for multidisciplinary critical care staff. A critical care nurse from the core work group educated a team of primary simulation staff members (an ICU attending physician and fellow and ICU nursing leaders) about the protocol and the checklist. Simulation staff members then conducted systematic simulation teaching on prone positioning (Figure 3). The ANCC from the core work group that developed the protocol organized the training sessions, and the ICU fellow created pretraining and postraining assessments and evaluations. Participants first viewed the 7-minute prone positioning video and then attended a 3-hour simulation laboratory session offered over a 3-month period based on the availability of the simulation laboratory and staff.

A high-fidelity manikin was used as the “patient” in a fully simulated room. The manikin was cannulated with a simulated triple-lumen catheter connected to intravenous pumps, and a simulated sutured arterial catheter was connected to an arterial catheter setup. Simulated peripheral intravenous access was also present. The manikin had a urinary catheter secured to the leg, and vital signs were displayed on a monitor. Rapid-cycle deliberate practice (RCDP), a simulation-based educational technique (repetitive deliberate practice and direct feedback provided within the simulation), was the chosen training method, with the ultimate goal of achieving mastery.24

At the start of the session, staff members were “pre-briefed” on the goals of the learning event, the methods of RCDP, the overarching philosophy of using the simulation laboratory as a safe space for learning and making mistakes, and the importance of learning effective communication skills. It was explained that the objectives of the simulation were to increase staff confidence in
Table Prone positioning checklist

Equipment needed before positioning (completed by primary RN of patient)

- Bag-valve mask with PEEP valve ready in room, connected to wall oxygen (oxygen turned off unless needed)
- EtCO₂ tubing and module attached
- Suction swivel connector attached to ventilator tubing (to allow for more slack and easier adjustment of ETT)
- Head positioner (gel head positioner preferred)
- Ophthalmic lubricant
- Paper tape (to keep eyes closed)
- Chest roll x 1
- Hip roll x 1
- Second flat or glide sheet for positioning/turning (1 should already be under the patient)
- 2 Extra pillows (for floating anterior feet and toes off of bed while prone)
- 10 Foam pads for pressure injury prevention: bilateral anterior feet, knees, hips, shoulders, cheeks
- A second set of ECG leads with electrodes attached for posterior torso placement when in the prone position
- TOF machine to assess neuromuscular blockade
- “Difficult airway” sign and paperwork to place above bed and in chart
- “Patient prone” sign for doorway

Orders needed (placed by physicians)

- Indication for duration of prone position (target goal is 16 hours if tolerated)
- Therapy discontinuation orders (when patient no longer shows a positive response to the position change or mechanical ventilation has been compromised)
- Frequency of ABG values (15 minutes before prone and 30 minutes after prone)
- Frequency of head repositioning (every 2 hours with RN, RT, and physician)
- Written orders for eye care (lubrication)
- Enteral feeding adjustments (hold 1 h before prone position, resuming TF at rate of 30 mL or less, hold 1 h before supine repositioning)
- Sedation orders to achieve deep coma induced state (RASS goal –5)
- If NMB agents are in use, TOF order with frequency and goal (goal 0/4 or 1/4).

Tasks to complete before positioning (completed by both physicians and nurses)

- Confirm family has been informed and indicates understanding of risks/benefits of procedure.
- Verify all necessary orders are placed (see list above).
- Confirm all necessary equipment has been obtained and in room (see list above).
- Place all signage necessary (“difficult airway” sign according to policy, “prone position” sign, STOP sign for door).
- Identify turning team members (attending physicians, 5 RNs, 2 RTs, additional turning support staff as needed).
- Perform situational awareness; inform charge nurse, manager, all MICU team members, RT, SICU residents, unit secretaries, nursing attendants that prone position will be in place (identify patient room).
- Assess and record baseline pulmonary/hemodynamic data:
  - Full set of VS, ventilator settings, pain and sedation score, TOF with an achieved 0/4 or 1/4 (if applicable)
  - Goal oxygen saturation of at least 90% (if this can be achieved)
  - Hemodynamic stability (no arrhythmias or extreme changes to baseline blood pressure)
  - Evaluate security of ETT or tracheostomy, secure as necessary/confirm lip level and appropriate tidal volumes
  - Perform line and dressing changes/reinforcement (central catheter/A-line; confirm sutures intact and secure) ALL prone patients MUST have an A-LINE and central catheter
- Arrange all IV lines, catheters, and drains: lines above the waist are positioned toward the head, below the waist toward the foot. Position chest tubes toward the feet.
- Apply SCDs, ensuring tubing is not causing pressure (if applicable)
- Confirm TF held x 1 hour (before turn)
- Check and confirm residual amount (report high residuals to fellow/attending physician)
- Thorough skin assessment performed and documented (clearly identify if skin is intact/location of wounds, abrasions, etc)
- Apply foam pads bilaterally to anterior shoulders, hips, arms, knees, feet, and cheeks.
- Empty ostomy bags (if applicable).
- Secure urinary catheter tubing to leg with stat lock/place padding between device and skin (ensure all anterior devices that cannot be disconnected are moved laterally to avoid PI).
- Apply rectal pouch if needed.
- Prepare second flat/glide sheet to be placed under patient to assist with prone turn.
- Provide oral care/suction.
- Complete eye care (apply ophthalmic lubricant as per order, cover with eye patches or paper tape).
- Obtain ABG values 15 minutes before turn.
- Apply fresh ECG leads to lateral torso, removing the anterior leads.

Continued
**Table Continued**

### Manual proning steps

Nurse leader confirms out loud they will provide step-by-step directions during the event. Before each action is performed, both RTs and IV-line RN should provide verbal confirmation that they are ready. Before each maneuver, seek readiness confirmation from RT and line nurse.

Place the second flat/glide sheet under the patient in the supine position.

Confirm the patient is in the center of the bed on top of the primary glide sheet. If not, take a moment to center the patient.

### To accomplish prone positioning:

**Step 1:** Lower all siderails. The team together moves the patient’s body in an upward position to allow the patient head to float off the mattress for easy rotation and airway protection and less obstruction. Both RTs at the head of the bed will support the head.

**Step 2:** Staff receiving the patient hold the bottom flat or glide sheet in place while the staff initiating proning pull the top flat or glide sheet, moving the patient laterally toward them to the very edge, almost off the bed and onto the knees of clinicians. If the patient is not pulled far enough laterally, the turn may not complete and the team will need to readjust and start over.

**Step 3:** Receiving staff now tuck the patient’s arm (on the side of the body in contact with the bed) slightly under the patient.

**Step 4:** Rotate the patient’s anterior body toward the receiving staff until the patient achieves prone position.

**Step 5:** Remove the second flat or glide sheet (used to assist the prone turn) from the bed (the majority of this sheet will be accessible and easy to remove).

Once the patient is prone, all staff work quickly to adjust extremities while both RTs (for airway and head repositioning) stabilize airway and face.

The whole team recenters the patient on the bed, shifting the patient’s body in a downward direction so that the head is able to rest on the mattress again.

The patient’s head is positioned either right or left facing (toward or away from the ventilator).

Reposition ECG leads from the lateral torso to the dorsal chest if necessary, ensuring that all wires are untangled.

Confirm with RT that airway is secure and perform the following to place the gel head positioner and chest and hip rolls:

**Step 1:** RNs positioned at each shoulder using the one float or glide sheet left under the patient, lift the patient torso upward off the bed while the remaining turn nurses place the chest roll just above or at the nipple line. Repeat this step at the mid-section for hip roll placement.

**Step 2:** Place pillow underneath bilateral shins to float anterior feet/toes not allowing them to rest on bed for PI prevention.

**Step 3:** Review and ensure all lines remain intact and functional.

**Step 4:** Place the patient in reverse Trendelenburg (about 10°) to maintain HOB elevation.

### Once patient is in prone position

Turn team to remain at bedside until patient is deemed stable.

Assess tolerance of full prone position: observe vital signs, oxygen saturation, appropriate tidal volume and peak airway pressures on the ventilator according to the patient’s supine baseline values. Ensure in-line suction can be passed easily in and out of the ETT and that patient can be suctioned without obstruction.

Confirm ETT lip level

Resume tube feeds at rate less than or equal to 30 mL/h.

Follow VS protocol (every 15 minutes/×1 hour), then per the unit protocol or patient condition.

Reposition head every 2 hours while prone:

**Step 1:** Place patient out of reverse Trendelenburg, RTs hold ETT, 2 RNs raise patient torso (lifting flat or glide sheet positioned at bilateral shoulders) while patient torso is raised, RTs turn head. Once head is repositioned, rehollow the gel head positioner making sure to off load ETT and all pressure points over bony prominences.

**Step 2:** During every 2-hour head repositioning, assess patient’s skin/face and need for additional protective foam pad placement for PI protection.

Support patient family.

### Return patient to supine position

Assemble team at bedside.

Lay bed flat, out of reverse Trendelenburg.

Check all lines/move all IVP pumps and tubing according to resupination direction.

2 RTs at head of bed confirm ETT securement to prepare for turn.

Confirm lip level.

Bring patient to supine position by reversing proning steps. (When returning to the supine position, must take into consideration arterial and IV access points must be taken into consideration. The goal is to not drag lines/tubes under the patient during the turn. Therefore, the head may need to be repositioned as an initial step to achieve this goal.)
performing the prone positioning maneuver, provide the opportunity to perfect the procedure while avoiding adverse outcomes for patients, and strengthen teamwork by enhancing communication between disciplines. Each simulation session included 1 critical care attending physician, 1 critical care fellow, 6 nurses (1 nurse leader, 1 catheter nurse, 4 turning nurses), and 2 respiratory therapists who had specific roles during the proning sequence. The first simulation cycle was an uninterrupted performance by the staff using the prone positioning checklist with a nurse leader providing directions. This step helped the learner understand the need for simulation training in the skill and was followed by a brief feedback session focusing on the most essential skills. A second simulation cycle followed, with the goal of achieving performance competence. The third simulation cycle was intended to achieve proficiency, with frequent interruption on skills acquired in previous cycles. This cycle was repeated until the team mastered the skills. A skill was considered mastered when the team demonstrated it without requiring redirection and met objective benchmarks while verbalizing understanding of the procedure.

Once the team had mastered the skills, the ICU fellow increased the difficulty of the scenario by triggering a surprise emergency cardiac arrest, placing the

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**Figure 3** Formal staff training in prone positioning protocol in simulation laboratory using high-fidelity manikin.
prone-positioned manikin into an unannounced fatal arrhythmia, which the team had to identify and address. The RCDP training steps were then repeated.

**Measurements**

A multiple-choice test and a self-survey using a Likert scale, designed by the ICU fellow overseeing the formal training, were distributed before and after simulation sessions to assess medical knowledge, management of ARDS including prone positioning, and confidence in performing a prone positioning procedure. The simulation curriculum and training for this project were overseen by 3 content experts in respiratory failure, prone positioning, and simulation education: the director of medical intensive care, the medical director of the simulation center, and an intensivist with a specialty in simulation. Postsimulation surveys and questions were used to evaluate the training, change in knowledge, and change in subjective opinions about confidence of use and management of prone positioning. Once the simulation training was completed, behavioral modification changes in the clinical environment—that is, staff increase in confidence while performing the procedure, compliance with the checklist, and independent initiation of preparation by the primary registered nurse—were assessed through observation by the ANCC and the director of the ICU during actual cases to measure progress and identify areas for improvement.

**Ethical Considerations**

This project’s use of in situ simulation and formal simulation training with mock patients and manikins was not associated with ethical concerns, as these methods eliminated risks to patient safety during protocol development and staff training. The clinical staff members who volunteered to serve as mock patients were not placed at risk, because all invasive catheters and artificial airways were simulated. In addition, each mock patient was able to communicate with the in situ testing staff about maneuvers or positions that felt uncomfortable, was frequently assessed by protocol developers, and was instructed to stop the event at any point if needed.

"Just-in-time" education, the use of actual ICU clinicians in place of manikins and simulation training, was used for protocol improvement and staff preparation.

**Results**

A total of 46 health care providers (25 nurses, 11 respiratory therapists, and 10 physicians) took part in the simulation training for manual prone positioning. Four of the physicians were critical care intensivists and 6 were pulmonary and critical care fellows.

The same questions were used on both the pretraining and posttraining surveys for assessing the ability to both recognize and manage patients with severe ARDS and confidence in performing the prone positioning maneuver. The posttraining surveys revealed a significant increase in confidence in both performing the maneuver and managing the patient while in the prone position.

Medical knowledge of ARDS was higher among physicians and nurses than among respiratory therapists. Each group had variable gaps in knowledge. Physicians scored higher on recognition of signs and symptoms of ARDS and the benefits of prone positioning and lower on timing of head repositioning and criteria for prone positioning.

Nurses scored higher on confidence in managing an ARDS patient (while supine) and knowledge of the causes of ARDS and lower on the benefits of prone positioning, criteria for prone positioning, and appropriate steps of the procedure. No respiratory therapists were able to identify criteria for proning or its benefits. The posttraining survey results revealed no significant change in medical knowledge.

The average time to recognition of a medical code was 19.3 seconds. The average time to resupinate a patient was 44 seconds. After a patient was resupinated, the average time to implement CPR was another 9.7 seconds. Following initiation of CPR, there was an additional 23.2-second delay in placement of the backboard on the patient’s bed. Cumulatively, this was a 73-second delay to the implementation of CPR. Simulation participants were not surveyed on but reported an increase in confidence in how to manage a medical emergency and resupinate a patient in the prone position. All participants verbally confirmed no prior confidence, experience, or knowledge regarding how to manage these events before training. We could not find any literature on emergency management of prone patients or national averages for time involved in resupinating patients to compare with our findings.

Just after the development of our standardized protocol and checklist for prone positioning, 6 patients with ARDS in the ICU met criteria for prone positioning, and the procedure was successfully performed in these patients.
with no adverse outcomes. The critical care staff demonstrated confidence in performing the procedure and using the checklist. Clinical nurse leaders and the director of the ICU observed that nurses showed earlier recognition of the ARDS cascade, with early recommendation for prone positioning to the medical team and room and patient preparation as specified in the checklist. Before training, nurses were concerned about adverse outcomes and reluctant to carry out the procedure. In each actual case, nurses were observed volunteering to be the nurse leader of the event and then providing effective and professional direction to attending and fellow physicians and respiratory staff during the procedure, as well as providing independent peer-to-peer training during actual events for nurses who were unable to attend formal training.

An unintended consequence of developing the high-definition training video is that staff members independently thought to view the video immediately before the actual event for “just-in-time” education. The ICU director either attended or participated in every post-training prone positioning event for actual ARDS patients. It was observed that the nurse-developed checklist led to a reliable, standardized, and organized process regardless of whether staff members had received formal prone positioning training.

Discussion

The development of a protocol for prone positioning for ARDS patients at our institution had several innovative features, including in situ simulation for protocol development and multidisciplinary team training using a live mock patient (an actual ICU clinician) instead of a manikin. Previous research indicates that standardization of the procedure through use of a checklist is the key to prone positioning safety and success.26 Our checklist enabled a consistent approach to the prone positioning procedure regardless of the specific clinicians carrying out the procedure or their exposure to formal training, taking the “thinking” out of a stressful situation. Our protocol became standard throughout the hospital and was explicit enough to use even when members of the team had not undergone complete training.

For high-risk, underused procedures, the use of simulation in developing a protocol and training staff is essential to prevent harm to actual patients.23,24 In our project, simulation provided a means of cost-effective experiential learning while simultaneously eliminating the risk of patient harm during the period of staff training and skills development.27

The use of ICU clinicians as mock patients during testing allowed invaluable and otherwise unattainable feedback such as the best position of the bed when repositioning the head to avoid painful hyperextension of the neck and preference for the reverse Trendelenburg position at 10° rather than the traditional head of bed position at 30° for comfort. Although most medical simulation training uses manikins, the use of live mock patients was especially helpful for testing our protocol because of the difficulty of maneuvering a real patient, as opposed to a stiff manikin, through the turning steps.28

This was especially true when determining how far to pull the patient laterally in order to complete the maneuver with the fewest readjustments.

Creating situational awareness was an especially important step not only for ensuring that all ICU staff members were ready to assist if necessary while the patient was in the prone position but also for educating families about the prone positioning procedure, thereby reducing their distress.

As previously indicated, an unexpected benefit of developing the high-definition prone positioning video was its use for “just-in-time” education and training for staff members, regardless of whether they had received formal training in prone positioning. The emphasis on multidisciplinary planning, testing, and training has had multiple positive outcomes, including respect for each other’s specific roles and responsibilities and strengthening teamwork and effective communication during actual prone positioning events.

As a result of this collaboration, staff members were able to offer additional ideas and suggestions for adjusting the protocol from various clinical perspectives. For example, during one of the simulation sessions, after observing a delay in treatment during a medical emergency when the patient was being resupinated, a staff member proposed implementing a standardized single method of resupination during a medical emergency. The suggestion was that whichever way the patient’s nose
was pointing should be the first direction the patient was pulled toward laterally to begin the turn, removing the need for discussion and therefore unnecessary delay of treatment. A sign was created to hang over the patient’s bed as a reminder that, in case of an emergency, “The Nose Knows” (Figure 4). The sign included a picture of a patient with an arrow pointing in the proper direction to prompt the staff during an emergency. This addition became part of the official checklist and protocol.

Posttraining survey results showed a significant increase in staff confidence in performing prone positioning and no significant change in medical knowledge of ARDS (which was already high before training as indicated by the pretraining surveys). The additional surprise of a medical code introduced into the simulation, a topic that has received limited attention in the literature, increased staff confidence in managing an emergency. Initially, the staff was caught by surprise and struggled through the first uninterrupted emergency code simulation cycle with a notable delay in treatment. After subsequent cycles, following steps 4 to 7 of the RCDP model, the average time to return the patient to the supine position and begin CPR was 63 seconds (a notable decrease in delay of treatment), with a range for all cycles of 23 to 133 seconds.

After development of the prone positioning protocol and completion of formal training, all actual prone positioning events were carried out with no adverse outcomes. The prone position was sustained for 16 hours, according to best practice recommendations, with no patient sustaining pressure injuries. After protocol development, critical care nurses and ICU physicians who were members of the core initial work group observed an increase in confidence and more effective communication during the procedure among newly trained staff, as evidenced by independent initiation of orders and required preparation of both room and patient, demonstrated confidence in head repositioning every 2 hours, active participation and efficient communication within a multidisciplinary team during the prone positioning event, offering suggestions and directives, and providing proactive feedback and instruction to peers who were participating in an actual case but had not undergone formal training.

A year and a half after development of our prone positioning protocol, we faced an unexpected crisis with the 2020 outbreak of coronavirus disease 2019 (COVID-19) caused by the severe acute respiratory syndrome coronavirus 2. In the spring of 2020, our hospital was located in the epicenter of the COVID-19 outbreak in the United States, and our ICUs were completely converted into COVID-19 wards. We treated an unprecedented number of patients diagnosed with COVID-19 pneumonia who presented with complications associated with ARDS, including profound hypoxemia refractory to oxygen therapy, pulmonary edema, and multiorgan failure.

Throughout the pandemic, both awake prone positioning and prone position ventilation with the patient sedated and receiving mechanical ventilation came to the forefront of conversation as a first-line treatment approach. Our protocol provided our institution with a strong foundation to use manual prone positioning of patients receiving mechanical ventilation during this
crisis; however, it was much too detailed to implement in its original form owing to the challenges we faced, including limited staffing, frequently changing equipment and medications, and need to limit exposure of clinicians to the virus. We modified our protocol on the spot, resulting in the frequent use of manual prone and supine positioning procedures, sometimes multiple times per shift for numerous patients. We estimate that through the height of the pandemic in the spring of 2020 (approximately 8 weeks), our ICUs performed prone positioning up to 250 times, including up to 7 times in a single 12-hour shift.

All positioning events were conducted successfully, with ease, and without adverse outcomes such as loss of airway or vital intravenous and arterial access. As a result of our intense and repeated use of manual prone positioning during the COVID-19 outbreak and the modifications we had to implement to our existing protocol, ICU physicians and nurses reported that manual prone positioning of critically ill patients in the ICU became less intimidating, and their confidence in carrying out the procedure was significantly increased as evidenced by independent use of the procedure among ICU nurses. Currently, our work group is in the process of adjusting our original protocol to eliminate steps and personnel based on what we learned during the pandemic, while still maintaining patient safety. The prone positioning protocol outlined in this article provided our unit with crucial guidance to meet the unprecedented challenges we faced during the COVID-19 outbreak, and its detailed stepwise process can be easily adopted by ICUs seeking to implement a protocol or improve an existing one.

Limitations

The findings presented in this article should be interpreted within the context of the following limitations. First, the tool used to assess confidence and medication knowledge was not previously assessed for content validity, and it is possible that the items in the tool did not directly assess the areas that they were intended to measure. Additionally, this simulation and assessment were performed on a single unit in a large urban hospital, and the results cannot be extrapolated beyond the patient population and unit dynamics present within our hospital.

Conclusions

Despite evidence indicating that prone position ventilation for patients with severe ARDS decreases mortality, concerns about adverse outcomes as well as facility and staff barriers have contributed to its underuse. At our institution, addressing these barriers head on by implementing in situ simulation for protocol development, using ICU clinicians as mock patients, standardizing the process, and committing to annual staff training and competency evaluation have mitigated the inherent risks of the procedure. Interdisciplinary team training has increased staff confidence and reduced fears associated with the maneuver, improved staff communication, and promoted respect for the unique roles of different team members. All of these factors support good patient outcomes.

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Financial Disclosures

None reported.

See also


References


