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IMPROVEMENT BRIEF

Increasing Rates of Prone Positioning in Acute Care Patients with COVID-19

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**Background:** Prone positioning improves mortality in patients intubated with acute respiratory distress syndrome and has been proposed as a treatment for nonintubated patients with COVID-19 outside the ICU. However, there are substantial patient and operational barriers to prone positioning on acute floors. The objective of this project was to increase the frequency of prone positioning among acute care patients with COVID-19.

**Methods:** The researchers conducted a retrospective analysis of all adult patients admitted to the acute care floors with COVID-19 respiratory failure. A run chart was used to quantify the frequency of prone positioning over time. For the subset of patients assisted by a dedicated physical therapy team, oxygen before and after positioning was compared. The initiative consisted of four separate interventions: (1) nursing, physical therapy, physician, and patient education; (2) optimization of supply management and operations; (3) an acute care prone positioning team; and (4) electronic health record optimization.

**Results:** From March 9, 2020, to August 26, 2020, 176/875 (20.1%) patients were placed in prone position. Among these, 43 (24.4%) were placed in the prone position by the physical therapy team. Only 2/94 (2.1%) eligible patients admitted in the first two weeks of the pandemic were ever documented in prone position. After launching the initiative, weekly frequency peaked at 13/28 (46.4%). Mean oxygen saturation was 91% prior to prone positioning vs. 95.2% after (p < 0.001) in those positioned by physical therapy.

**Conclusion:** A multidisciplinary quality improvement initiative increased frequency of prone positioning by proactively addressing barriers in knowledge, equipment, training, and information technology.

In March 2020 the World Health Organization declared COVID-19 a pandemic. To date, COVID-19 has caused at least 4.7 million deaths worldwide, with 230 million cases.1 Treatments and interventions to modify progression of illness in those diagnosed with COVID-19 are still needed. Placing patients on their stomach, known as prone positioning, has been suggested as one procedure to reduce morbidity and mortality in patients suffering from respiratory failure with COVID-19.

Prone positioning has mainly been studied in patients who are intubated. The landmark PROSEVA study demonstrated a substantial decrease in mortality in this cohort of patients.2 In theory, the benefits of prone positioning should apply to nonintubated patients as well. Several small studies have suggested that prone positioning in nonintubated patients improves oxygenation and may decrease the need for intubation.3,4 Placing nonintubated COVID-19 patients in the prone position may be a way to improve oxygenation and thereby prevent the need for intubation.3–10

However, placing patients who are awake in the prone position poses particular challenges that are not shared by intubated and sedated patients, such as decreased time in the prone position due to patient discomfort, which may reduce efficacy.11 Also, patients with decreased mobility have difficulty getting into the prone position on their own. This may exclude patients in high-risk COVID-19 categories such as older patients and patients with higher body mass indexes. Prone positioning also requires additional supplies and equipment to reduce discomfort and prevent injury.

Below, we describe an initiative to address these limitations at our hospital during the initial peak of the COVID-19 pandemic in New York City. This was a multicomponent and rapidly deployed initiative with only a few weeks of experience with COVID-19 in the United States. The aim of the acute care prone positioning initiative (ACPPI) was to increase prone positioning in nonintubated patients on the acute care floors (that is, not in the ICU). This was done by revising policies and procedures, implementing strategies to increase patient comfort, educating staff and patients, collaborating with supply chain to obtain necessary supplies, creating a novel team of physical therapists (PTs) to assist in prone positioning, and developing new electronic health record capabilities.
METHODS

Setting
The ACPII took place at a large New York City academic, quaternary, Magnet-designated hospital licensed for 844 beds. The hospital is part of an integrated hospital network comprised of four stand-alone hospitals and a children’s hospital within a hospital. The ACPII consisted of four concurrently planned interventions, the first of which launched on April 9, 2020. We also describe subsequent modifications made after initial planning.

Study Population
Inclusion criteria included a positive polymerase chain reaction (PCR) test for SARS-CoV-2, a principal diagnosis consistent with COVID-19 disease, and need for at least 4 liters of oxygen. Patients were included if they were admitted to the acute care floors between March 9, 2020, and August 26, 2020. Patients were included in the prone positioning group if any (one or more) recorded instance of prone positioning occurred based on the vitals flowsheet in the electronic health record, or if the patient was recorded as being assisted by the prone positioning team. Patients were included regardless of whether they went on to be intubated or transferred to the ICU. The initial pilot was implemented on two 34-bed units that held patients with higher oxygen needs.

Intervention 1: Nursing, Physician, and Patient Education
A nursing education plan was developed by the Wound, Ostomy & Continence (WOC) nursing team taking into consideration assisting the patient, protecting them from injury (for example, skin injuries), and the presence of medical devices.12 We developed and distributed an illustrated, detailed prone positioning one-pager for staff from which nurses could learn visually (Figure 1). Video education was also created to supplement the didactic written and in-person education. We created a step-by-step video on how to position the acute care nonintubated patient into a prone position. A one-pager with educational material for patients was also created (Figure 2) to be distributed by nurses and PTs.

Updates on development of the acute care prone positioning team and information on prone physiology and research were delivered to physicians, nurse practitioners, and physician assistants via the “Covid Daily,” a daily e-mail newsletter distributed to clinicians involved in the care of patients with COVID-19.

Intervention 2: Supply Management and Operations
Prone positioning in general and during the COVID-19 era has been linked to increased pressure injuries.13,14 The WOC nurse specialists used the 2019 National Pressure Injury Advisory Panel International Guideline to influence which products and supplies the staff and patient would need for safety considering time and cost efficiency.15 An existing pressure-distributing cushion was promoted for use under bony prominences when a standard pillow was too high or uncomfortable for the patient’s body habitus (for example, face, chest). Prophylactic, multilayer composite silicone-bordered foam dressings were used on the bony prominences for patients with altered mobility or sensation as per their risk assessment subscales (for example, knees).

The WOC nurse consultants worked to procure additional standard pillows from the manufacturer and increase the quantity of pillows stocked on the acute care floors within the newly expanded hospital census.

Intervention 3: Acute Care Prone Positioning Team
Specialized prone positioning teams have been described in the ICU setting in ventilated patients during COVID-19.16 We developed a novel prone positioning team specifically for those patients who are not intubated and on the acute care floors.

PTs were trained in how to identify appropriate candidates on the medical floors using Guidance for: Prone Positioning in Adult Critical Care from the Intensive Care Society.17 Best methods were established for assisting patients of varying functional abilities. The disposable patient transfer sheet, which reduces friction when moving patients in bed or from surface to surface, was used for more functionally dependent patients to minimize their metabolic demand. The staff were educated on how to offload bony prominences for patients in the prone position and to encourage paced, relaxed breathing during maneuvers. Therapists were instructed to closely monitor vital signs, ensuring that they were maintained within safe limits.

The team consisted of two to three PTs who compiled a list from the electronic health record of acute-level patients being treated for COVID-19 and “keep prone” orders. These orders could be placed by nurse practitioners, physician assistants, residents, or attending physicians. Contraindications for prone positioning included acute medical decompensation requiring imminent upgrade to the ICU, delirium, spinal instability, severe osteoporosis, or unstable orthopedic injury, and patients with these conditions were not seen by the prone team. Prone positioning was done by the team during evening hours to avoid mealtimes and medication administration and to promote prone positioning during sleep.

Intervention 4: Electronic Health Record Optimization
To capture data effectively and allow for efficient documentation, note templates were created within the electronic health record for each patient seen by the prone positioning team. Data points collected included medical record number, date, initial and final patient position, oxygen sat-
Figure 1: Shown here is an illustrated, detailed “one-pager” that was developed to provide visual education for nurses on prone positioning of nonintubated patients.

Challenges and Modifications

Periodic e-mails and scheduled weekly conference calls were undertaken with the prone positioning team to identify successes and failures of prone positioning. On two separate occasions, physicians rounded with the prone positioning team to learn technique and troubleshoot.

Two such challenges were desaturations and coughing during the actual process of prone positioning. Although patients often recovered after being settled in prone position, drops in SpO2 during the procedure were a barrier for safety and tolerability. Using a stepwise approach to prone positioning helped address this issue. This meant positioning patients in a lateral recumbent position and allowing them ample time to improve oxygenation and/or stop coughing, sometimes up to a few minutes. The team would then complete the procedure by turning the patient from lateral to prone. Use of antitussives was also proposed.

Anxiety regarding the prone positioning procedure was another barrier. For patients who could not return to supine position on their own, part of this anxiety was possibly related to being unable to reach others should they become uncomfortable or need assistance. Placing telephones, call buttons, and other devices (for example, smartphones) within reach reduced anxiety and promoted safety. Pharmacologic intervention for sleep such as melatonin and/or anxiolytics (for example, benzodiazepines) were also proposed for select cases.

We modified patient triage criteria during the course of this initiative. Certain patients with limited mobility (for example, maximal or full assistance) often took a disproportionate amount of time in positioning and tended to stay in the prone position for a relatively short amount of time. The team thus began to triage and focus on patients who required moderate assistance. The con-
result process was improved by launching an e-mail consult listerv.

Measures and Analysis

Our principal outcome measure was one or more instance of prone positioning during hospitalization while on an acute care floor. In the subgroup of patients who later went on to be intubated or transferred to the ICU, all prone positioning after these events was excluded. This was a retrospective analysis. We captured the total prone positioning through documentation in the electronic health record or documentation by PTs’ log. There were no other ongoing initiatives at our institution specifically aimed at increased prone positioning in the acute care population. The preintervention period was from March 1 to April 8, 2020; the active intervention period was from April 9 to May 22, 2020; and the postintervention period was from May 23 to August 26, 2020. These were grouped by week for purpose of analysis. Of note, the run chart indicates patients with any prone positioning by week of admission, not by timing of prone positioning, though the mean time from admission to first instance of prone positioning was seven days.

We described the study cohort and the weekly frequency of prone positioning at the study institution. We display this in a run chart and use standard rules to identify special cause variation.16 We compared characteristics of prone positioned and not prone positioned patients using the chi square test or Kruskal-Wallis test for nonparametrically distributed continuous variables. Given that the targeted education and prone positioning components of the initiative were undertaken at only one of the health system hospitals, we compared overall frequency of prone positioning among the three sites during the intervention period using the chi-square test. These other hospitals are nearby and were similarly affected by the initial wave of COVID-19.

We also completed a subanalysis of the patients placed in the prone position by the acute care prone positioning team, assessing change in SpO2 immediately prior to and after prone positioning using a paired t-test. All analyses were conducted with SAS 9.4 (SAS Institute Inc., Cary, North Carolina), all statistical tests were two-tailed, and we used \( p < 0.05 \) to determine statistical significance. The evaluation was approved by the NYU Institutional Review Board, which granted a waiver of patient consent.
RESULTS

During the study period, a total of 5,322 COVID-19 patients were admitted to our health system. Of these, 1,226 were excluded because they had non-COVID-19 primary diagnosis, 1,396 were excluded due to O₂ requirements < 4 L, and 200 were excluded because of direct admission to the ICU. A total of 1,625 were admitted to other hospitals in our health system that were not part of this initiative. This left 875 patients who met inclusion criteria. Of these, 176 (20.1%) were placed in the prone position at least once prior to intubation or ICU transfer during the full study period; from preintervention, to intervention, to postintervention, rates were 77/548 (14.1%), 97/312 (31.1%), 2/15 (13.3%), respectively. Of the 176 patients, 43 (24.4%) were assisted by the prone positioning team.

Characteristics of patients who were placed in the prone position compared with those who were not are shown in Table 1. A run chart of the total number and percentage of patients in the prone position is displayed in Figure 3. The chart begins 4 weeks prior to the launch of the prone positioning team and ends 14 weeks after the intervention.

Table 1. Characteristics of People with COVID-19 Admitted to the Acute Care Floors at Any Point During the Acute Care Prone Positioning Initiative

| Characteristics                  | Any prone positioning on acute care floor | p value |
|----------------------------------|------------------------------------------|---------|
|                                  | No, n = 699                               | Yes, n = 176 |
| Median age in years (IQR)        | 66 (56–76)                                | 65 (57–75) | 0.6 |
| Obesity (%)                      |                                          |          |
| BMI ≥ 40 kg/m²                   | 67 (9.6)                                  | 10 (5.7)  | 0.04 |
| BMI 30 to < 40 kg/m²             | 236 (33.8)                                | 48 (27.3) |         |
| BMI 25 to < 30 kg/m²             | 237 (33.9)                                | 66 (37.5) |         |
| BMI < 25 kg/m²                   | 148 (21.2)                                | 45 (25.6) |         |
| Unknown                          | 11 (1.6)                                  | 7 (4.0)   |         |
| Female (%)                       | 246 (35.2)                                | 60 (34.1) | 0.78 |
| Race/ethnicity (%)               |                                          |          |
| Asian                            | 41 (5.9)                                  | 24 (13.6) |         |
| Black, not Hispanic              | 88 (12.6)                                 | 20 (11.4) |         |
| Hispanic                         | 109 (15.6)                                | 41 (23.3) |         |
| Other/multiracial                | 61 (8.7)                                  | 12 (6.8)  |         |
| Unknown                          | 34 (4.9)                                  | 5 (2.8)   |         |
| White, not Hispanic              | 366 (52.4)                                | 74 (42.0) |         |
| Any chronic condition (%)        | 580 (83.0)                                | 144 (81.8) | 0.72 |
| Any cardiovascular condition (%) | 453 (64.8)                                | 118 (67.0) | 0.58 |
| DM (%)                           | 262 (37.5)                                | 60 (34.1) | 0.4 |
| Asthma or COPD (%)               | 115 (16.5)                                | 30 (17.0) | 0.85 |
| CKD (%)                          | 139 (19.9)                                | 29 (16.5) | 0.3 |
| Cancer (%)                       | 102 (14.6)                                | 24 (13.6) | 0.75 |
| O₂ at admission (%)              |                                            |          |
| 89–92                            | 195 (27.9)                                | 50 (28.4) | 0.006 |
| 93–100                           | 369 (52.8)                                | 74 (42.0) |         |
| < 88                             | 135 (19.3)                                | 52 (29.5) |         |
| Median (IQR) CRP (mg/dL)         | 124 (69.2–189.2)                          | 132.55 (92.65–209.3) | 0.02 |
| Median (IQR) D-dimer (ng/mL)     | 424 (257–869)                             | 382 (254–629) | 0.07 |
| Median (IQR) Troponin (ng/mL)    | 0.02 (0.01–0.05)                          | 0.02 (0.01–0.04) | 0.28 |

IQR, interquartile ratio; BMI, body mass index; DM, diabetes mellitus; COPD, chronic obstructive pulmonary disease; CKD, chronic kidney disease; CRP, C-reactive protein.

We did a subanalysis of the change in oxygen immediately prior to and after prone positioning for the 43 patients assisted by the prone positioning team. This included a total of 87 instances of prone positioning (some positioned more than once). The mean SpO₂ prior to prone positioning was 91%; after prone positioning it was 95.2%, which was a statically significant improvement (p < 0.001). Note that each instance of prone positioning (rather than each patient) was counted individually, unlike in the main analysis.
DISCUSSION

We found that a multicomponent acute care prone positioning initiative may have helped to increase the frequency of prone positioning in nonintubated patients outside the ICU. Whereas only 2/94 eligible patients admitted in the first two weeks of the COVID-19 pandemic were positioned prone at any point, we reached a maximum of 46.4% by the third week of the initiative. Changes were required to institutional policy, nursing education, patient education, electronic health record capability, supplies on the unit, and physical therapy role definitions. It is notable that frequency of prone positioning was lower at other network hospitals that had the same information technology system and institutional policies, but did not have the in-person prone positioning team or in-person nurse education and supply changes (Figure 4).

The increase in frequency of prone positioning after the start of the intervention and the drop after components were stopped make it likely that the intervention was responsible for the observed changes. However, it is possible that increased frequency had to do with increased knowledge of prone positioning separate from our initiative. We do, for instance, observe increases at other hospitals, albeit smaller ones.

Outcome studies of prone positioning in nonintubated COVID-19 patients have been inconclusive. A prospective, multicenter cohort study by Ferrando and colleagues comparing high-flow nasal oxygen with and without prone positioning failed to show a reduction in the risk of intubation. Another small study did suggest possible mortality benefit. In an article by Zang, two groups were compared: 23 patients who received early prone positioning and 37 who did not. At 90 days, mortality was 43.5% compared to 75.7% ($p = 0.0004$). We conducted a subanalysis of the patients assisted by the prone positioning team, adding to evidence that prone positioning does in fact improve SpO2. However, further data are needed on outcomes of interest, such as reduction in intubation rates, hospital length of stay, and mortality.

This work can serve as a blueprint for other centers to help promote prone positioning among acute care patients who are hospitalized with COVID-19. Other institutions have published educational materials to promote prone positioning and demonstrated feasibility of prone positioning in this cohort. However, this represents the first report of a comprehensive, multicomponent effort to promote prone positioning in the acute care setting.
**CONCLUSION**

Although it is a seemingly simple intervention, prone positioning can often be labor intensive and requires education of PTs, nurses, and physicians to implement safely and successfully. Here we demonstrated how to rapidly deploy an acute care prone positioning initiative in real time during a pandemic for which extensive planning was not possible. Further study is needed to better assess how these interventions can help promote longer times spent in the prone position and how it is related to various outcome measures.

**Figure 4:** This run chart shows the percentage of acute care patients ever placed in the prone position, by admission week and facility, among those with COVID-19 and requiring ≥ 4 L O₂.

**Limitations**

There were several limitations. We did not collect data on the total time patients spent in the prone position. Although we implemented strategies to help maximize prone positioning time (such as having the prone positioning team round in the evening), without this data we can’t demonstrate that people were actually in position for longer. We also did not include patients who were not intubated but placed in the ICU. Given changing patterns of intubation and ICU admission during the beginning of the pandemic, this can represent a confounder. Finally, it is difficult to separate improved documentation of prone positioning from actual increased frequency of prone positioning.

**Conflicts of Interest.** One author worked as a consultant for Medline Industries, Inc. as a Skin Health Advisory Board Member; no financial relationships with any organization that might have an interest in the submitted work in the previous three years; no other relationship or activities that could appear to have influenced the submitted work.

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