Research

Retrospective Investigation of the Effects of Manual Pronation in a United States Community-Based Hospital Intensive Care Unit During the COVID-19 Surge Crisis

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ABSTRACT

Background

Patients with acute respiratory distress syndrome suffer a high mortality rate; however, manual pronation provides a survival advantage of up to 17%. March 2020 marked the initial COVID-19 surge in the US, characterized by government lockdowns, inundation of healthcare systems, and high patient fatality levels. Initially, COVID-19 patients admitted to our facility who might benefit from manual pronation were transferred to other local facilities until our interdisciplinary team implemented a manual pronation policy within 27 days of receiving our first COVID-19-positive patient.

Aim

The aim of this study was to describe the impact of a community hospital partaking in manual pronation for the first time, quality care metrics—specifically central line-associated bloodstream infections (CLABSIs), catheter-associated urinary tract infections (CAUTIs), and ventilator-associated pneumonia/events (VAP/VAEs)—associated with the COVID-19 surge, and the barriers overcome during this process.

Methods

This retrospective chart review included measures of hypoxemia and oxygenation, intubation, and discharge and quality safety data from March 13 to June 1, 2020, for patients who underwent manual pronation.

Results/Findings

Pronation occurred a total of twenty-seven times in 13 patients (seven [53.8%] survived, and six [46.2%] died during hospital admission). Four (57.1%) of the patients who survived were discharged home, two (28.6%) went to a rehabilitation facility, and one (14.3%) was transferred to an outside hospital. Zero CAUTIs (458 catheter days), CLABSIs (371 central line days), and VAEs (384 ventilator days) occurred during the study.

Conclusions

With the newly acquired proning policy in place and creative COVID-19 care, data were consistent with an overall improvement in patient outcomes. Manual pronation was shown to improve P/F (partial pressure of oxygen [PaO_2]/fraction of inspired oxygen [FiO_2]) ratios. There were no upticks in hospital-acquired infections, notably CAUTIs, CLABSIs, and VAP/VAEs, at our facility.

Key Words: COVID-19, manual pronation, P/F Ratios, CLABSI, CAUTI, VAP/VAE

INTRODUCTION

On December 12, 2019, a group of individuals in Wuhan, China, began exhibiting similar symptoms with an unknown etiology (CDC, 2022). Shortly thereafter, on January 7, 2020, a novel coronavirus was identified and isolated by the Chinese Center for Disease Control and Prevention (CDC, 2022; Chen et al., 2020). On January 20, 2020, the first case of COVID-19 was confirmed in the United States of America (USA) (CDC, 2022). According to the World Health Organization (WHO) (2022), COVID-19 is caused by the SARS-CoV-2 virus, which is spread from person to person through droplets. Although COVID-19 can infect any individual, those of older age and with underlying comorbidities—asthma, chronic lung disease, immunocompromised, chronic kidney disease on dialysis, diabetes, liver disease, obesity, and severe heart conditions—present with increased illness warranting more aggressive medical intervention (Makic, 2020; WHO, 2022).

The initial COVID-19 surge occurred in the Midwest region of the USA from March 2020 through June 2020, inundating healthcare workers with ongoing changes in practice as well as access to limited resources to provide optimal care to patients testing positive for the virus. In the USA, from March 1, 2020, through May 31, 2020, there were 1,786,044 confirmed COVID-19 cases and 107,791 reported deaths (Johns Hopkins University of Medicine, 2022). During this timeframe, intensive care units (ICUs) were quickly filled with high-acuity COVID-19 patients, many of whom required mechanical ventilation. As elective surgeries were being canceled, specialty ICUs were being converted into COVID-19 ICUs. These COVID-19 ICUs stayed updated with the most recent practice guidelines based on constantly changing evidence learned from a global perspective about the virus and treatment modalities. For patients admitted to ICUs, it was predicted that this viral surge and lack of resources would translate to higher rates of nosocomial infections, such as catheter-associated urinary tract infections (CAUTIs), central line-associated bloodstream infections (CLABSIs), and ventilator-associated pneumonia/ventilator-associated events (VAP/VAEs) due to the increased catheter and central line insertions and duration, increased number of patients requiring mechanical ventilation, staff shortages, and longer lengths of stay (McMullen et al., 2020). Additionally, time dedicated to preventing healthcare-associated infection compliance drastically decreased because of the increased acuity of the COVID-19 patient population and staff attempts to limit their viral exposure (McMullen et al., 2020).

COVID-19 Related Acute Respiratory Distress

Acute respiratory distress syndrome (ARDS) was typically seen in initial critically ill COVID-19 patients before standards of care for this new population were

developed. During this time, P/F ratios (PaO2/FiO2) were utilized to identify acute hypoxemic respiratory failure in patients receiving supplemental oxygen. The P/F ratio is calculated by the partial pressure of oxygen (PaO_2) divided by the fraction of inspired oxygen (FiO_2). The Berlin Criteria for ARDS defines the severity of hypoxemia as the following: mild (P/F ratio between 300 and 201 mmHg), moderate (P/F ratio between 200 and 101 mmHg), and severe (P/F ratio ≤100 mmHg) (Makic, 2020). For patients with ARDS, which carries a 40% mortality rate, initial ventilator recommendations focus on lung protective strategies—low tidal volume ventilation and plateau pressure <30 cm H_20—in the supine position (Malhotra, 2022).

Prone Positioning for COVID-19 Related ARDS

When patients develop severe ARDS with refractory hypoxemia (inadequate arterial oxygenation despite optimal levels of inspired oxygen) and do not respond to lung protective strategies, clinicians then determine the appropriateness to manually prone (Malhotra, 2022). According to Makic (2020), prone positioning allows ventilation to recruit the dorsal alveoli (unavailable in supine positioning), thus promoting further optimal gas exchange. Proning protocols for adult critical care patients are found in the literature (Bamford et al., 2019). Prone positioning has been established as a standard interventional treatment in patients who develop ARDS, including COVID-19-afflicted patients (Makic, 2020). Manual pronation is utilized in about 32.9% of patients with severe ARDS but remains highly underutilized despite a survival advantage of up to 17% (Ghelichkhani & Esmaeli, 2020; Montanaro, 2021).

Around the world, adjustments to clinical practice and operational procedures, as well as initiation of prone positioning, were immediately identified in order to optimize COVID-19 patient outcomes and keep healthcare providers safe (Bein et al., 2020; Chen et al., 2020; Lindahl, 2020; Mitchell & Seckel, 2018). Manual pronation of a patient is a step-by-step process that involves maneuvering a patient from lying on their back and turning them onto their stomach. This maneuver requires the involvement of several healthcare members to safely turn a patient without dislodging any tubes that may be present (i.e., endotracheal tubes, central lines, peripheral intravenous catheters, etc.). Some providers are reluctant to utilize prone positioning for the following reasons: low degree of confidence, lack of staff competency training, and severity of hypoxia and hemodynamic instability potentially leading to adverse outcomes (Ghelickhani & Esmaeli, 2020; Montanaro, 2021).

Purpose

The purpose of this study was to retrospectively review ICU patients' clinical and safety data as well as processes, such as manual pronation, taken to ensure improved patient outcomes and staff safety during the initial 2020 COVID-19

pandemic surge. It was hypothesized that manual pronation would positively increase patients' P/F ratios. Additionally, it was hypothesized that strict adherence to the basic practice guidelines toward CLABSI, CAUTI, and VAP/VAE prevention measures would allow our facility to maintain strong quality metric data similar to that pre-pandemic.

METHODS

Design

We conducted an exploratory descriptive study based on a retrospective chart review.

Setting

Data reviewed was from the 14-bed ICU of a community hospital (185 total inpatient beds) in the Midwestern USA that is a two-time Magnet® recognized hospital, a recipient of the American Association of Critical Care Nurses Beacon gold (2018) and silver (2021) awards, and part of a larger health system.

Sampling and Data Collection

Data reviewed was from March 13 to June 1, 2020, and included the number of patients manually proned, the number of proning events, patients' P/F ratios pre- and post-pronation, the number of COVID-19 intubations, and discharge destination for patients who underwent manual pronation. Because quality metrics were sub-par across the nation, our facility collected data to compare to both the state and national benchmark levels. Quality metrics evaluated at the unit level included the number of CAUTIs, CLABSIs, VAP/VAEs, the number of COVID-19-related respiratory/cardiac arrests, and the number of staff who contracted COVID-19.

Ethics

Approval from the Institutional Review Board was received for this research study.

Data Analysis

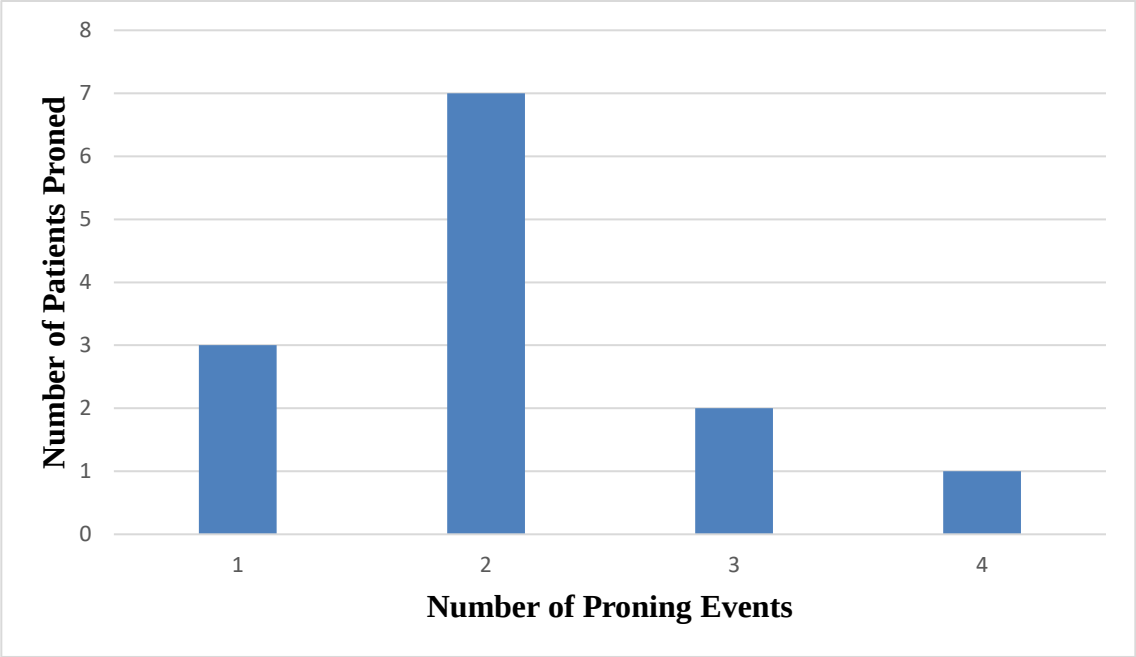
Standard descriptive statistics were computed using Microsoft Excel. We did not employ inferential statistics and adjusted analyses due to the small sample from one single center and the exploratory scope of this work.

RESULTS

On March 13, 2020, the first COVID-19-positive patient was admitted to our hospital in the ICU. The first COVID-19 intubation was on March 29, 2020, and the first patient manually proned at this facility was on April 10, 2020. Thirteen individual patients were proned for a total of twenty-seven proning events during the observation period. Three patients (23%) were proned once, seven patients (54%) were proned twice, two patients (15%) were proned three times, and one patient

(8%) was proned four times. See Figure 1 (below). We followed our guidelines of sixteen hours in the prone position for patients and did not track the exact amount of time each of the patients were proned.

Figure 1.
Number of Proning Events per Proned Patient

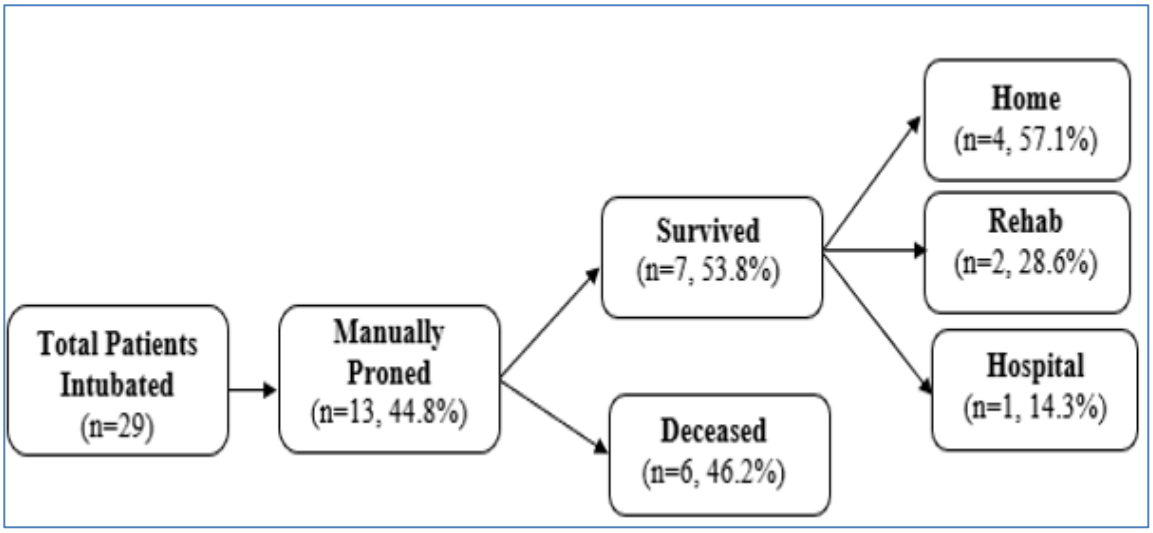


Of the twenty-nine patients receiving mechanical ventilation, thirteen (44.8%) of those patients were manually proned. Of these thirteen patients, seven (53.8%) survived, while six (46.2%) died during their hospital admission. Of the patients who survived their hospital admission: four (57.1%) were discharged home, two (28.6%) went to a rehabilitation facility, and one (14.3%) was transferred to an outside hospital for higher acuity services not currently available at this institution. See Figure 2.

Of the 27 proning events, the mortality rate was 51.9%, while the survival rate was 48.1%. In all groups, we observed positive improvements in patients' P/F ratios from pre- to post-pronation. Figure 3 details patients' pre- and post-pronation P/F ratios at the time of each manual proning event, with some patients proned more than once (refer to Figure 1). Due to the small sample size and lack of a comparative group, p-values were not computed as they would not show statistical significance.

Figure 2.

Manual Pronation and Discharge Destination of Patients



During the observation period, there were zero CAUTIs (458 catheter days), CLABSIs (371 central line days), and VAP/VAEs (384 ventilator days) which was similar to pre-pandemic unit-level quality metrics. There were also no endotracheal tube or central line dislodgements. Sixteen COVID-19 related respiratory/cardiac arrests occurred hospital-wide, warranting the activation of the Code Blue team (which are the ICU registered nurses (RNs) at this organization). While potential staff exposure was elevated due to the number of emergency responses and the extra time dedicated to proning patients, only one direct-care ICU staff member contracted the virus during this period.

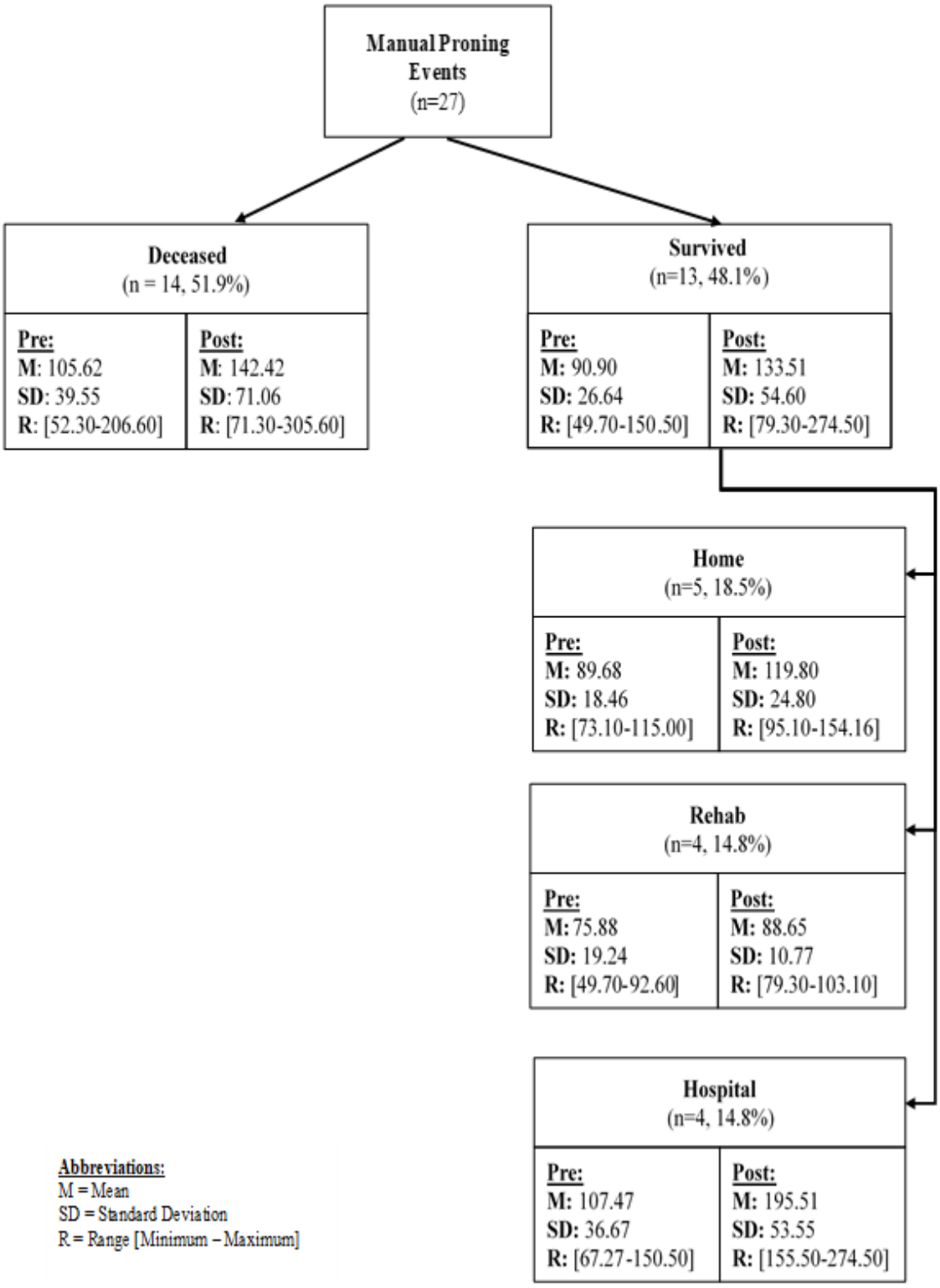
DISCUSSION

Drive to Prone

Initially during the COVID-19 surge, patients at our hospital who could benefit from manual pronation while mechanically ventilated were transferred to other local facilities, as we had never utilized pronation. Pronation was not utilized pre-pandemic as there was a lack of appropriate patients meeting ARDS criteria at our facility. However, area ICUs quickly began to reach maximum capacities statewide. Our hospital utilizes a shared governance nursing model that allows decision making to be distributed between current bedside nurses and leadership, which in turn promotes positive patient outcomes and improves overall job satisfaction (McKnight & Moore, 2021). Through this model, the ICU nursing team demonstrated superb advocacy and unit collaboration to gain approval from hospital leadership to implement manual pronation for the very first time at this

Figure 3.

Pre and Post P/F Ratios of Manual Proning Events by Survivability and Discharge Destination of Patients



institution. With the immediate support and advocacy of the entire interdisciplinary team, policies were quickly adopted and tailored to meet the needs of our hospital and community, which allowed manual pronation to be performed during the initial COVID-19 surge.

Nosocomial Infections/Quality Metrics

During the global COVID-19 surge, critically ill patients required central line access more often than usual for hemodynamic instability. Prone positioning can result in pulling, tugging, and friction at central line insertion sites (McMullen et al., 2020). Additionally, the reduced visualization of line insertion sites and substance buildup can contribute to compromised dressing integrity. In order to reduce staff exposure and preserve personal protective equipment (PPE), vigilant hand hygiene was likely lacking, thus cross contamination rates increased (McMullen et al., 2020). Lastly, hesitancy regarding removal of unnecessary indwelling urinary catheters and central lines was likely, as alternatives would require additional clinician exposure and time from the existing short-staffed critical care team members (McMullen et al., 2020).

Based on the data reported to the National Healthcare Safety Network, from April to June 2020, there was a 27.9% increase in CLABSIs, minimal change in CAUTIs, and a 33.7% increase in VAEs nationwide (Weiner-Lastinger et al., 2021). During the same timeframe in Illinois, there was a 7.1% decrease in CAUTIs, 47.8% increase in CLABSIs, and an 88.3% increase in VAEs (Weiner-Lastinger et al., 2021). CLABSIs were expected to have the highest impact on hospital-acquired infections due to COVID-19 patients having acute kidney injuries requiring increased use of dialysis lines (McMullen et al., 2020). In addition to increased central line insertions, nursing care shifted toward more clustered care to decrease the use of PPE, thus tasks were being rushed to minimize exposure time; also, non-critical care staff was redeployed to critical care areas where there may have been a knowledge deficit in CLABSI prevention measures (McMullen et al., 2020). National guidelines for CLABSI prevention include frequent hand hygiene, proper insertion practices utilizing aseptic technique and appropriate location selection, daily bath with chlorhexidine (CHG) preparation, routine dressing changes with the use of CHG-impregnated disk, routine infusion tubing changes, and scrubbing open access ports with antiseptic (or utilizing CHG impregnated caps) prior to use (CDC, 2011). Increased CAUTIs can be attributed to poor hand hygiene compliance, hesitancy to remove the catheter, and knowledge gaps among redeployed staff (McMullen et al., 2020). National core prevention strategies for CAUTIs include frequent hand hygiene, insertion of a catheter for appropriate indication by trained staff utilizing aseptic technique, maintaining unobstructed urine flow and closed drainage

system, and only leaving catheters inserted for as long as necessary (Gould, n.d.). Basic practice guidelines for prevention strategies against VAP included: patient's head of bed greater than 30 degrees if not contraindicated, daily wean and/or cessation of sedation for spontaneous breathing trial, frequent oral care and suctioning (oral, oropharyngeal, and endotracheal routes), maintain closed ventilator circuit (only change if visibly soiled or malfunctioning), and early mobility (Klompas et al., 2014).

Our hospital diverted staff to more familiar areas, for example, RNs from the operating room (OR) and post-anesthesia care unit (PACU) were redeployed to the ICU, where central lines and indwelling catheters are commonly used, thus CLABSI and CAUTI prevention measures are well known to this population of staff. The safety of staff was of utmost importance during this period. To ensure proper donning and doffing of PPE, a new role was created for redeployed staff who became known as "PPE Buddies," ensuring each person entering and exiting the rooms were completely covered with PPE and compliant with hand hygiene protocols. Additionally, we utilized non-invasive equipment, for instance, external male and female catheters, and have a nurse-driven protocol to discontinue indwelling urinary catheters. Lastly, to minimize VAP/VAEs, strict adherence to our hospital's VAP/VAE guidelines were maintained while working in conjunction with our respiratory therapists (RTs).

Despite the challenges our healthcare workers faced during the COVID-19 surge, the ICU was able to maintain and improve our strong quality pre-pandemic metric data due to our immaculate attention to detail, indwelling urinary catheter removal nurse-driven protocol, and dedicated time toward preventing nosocomial infections. The pre-pandemic quality metric practice guidelines did not change during the COVID-19 surge.

Limited Resources/Barriers

As manual pronation was not performed at our hospital prior to the COVID-19 pandemic, the proning policy was adopted from one of our partner institutions. Additionally, one of the ICU Intensivists, ICU Clinical Nurse Leaders (CNLs), and the RT department collaborated and initiated a COVID-19 rapid sequence intubation policy to minimize staff exposure to the virus.

While many surrounding institutions had specific teams dedicated to proning, during the surge, our facility relied on the ad hoc recruitment of other units and disciplines—from emergency department (ED) RNs, medical-surgical RNs, CNLs, physicians, patient care technicians, physical therapists, occupational therapists, RTs, OR RNs, and PACU RNs—in order to make the nurse-led pronation initiative a success. Staff received training by reviewing the newly adopted policy and watching a video on performing manual pronation and supination procedures.

Under the discretion of the physician, the recruited individuals were able to manually prone and supinate patients without incident. The recruitment and support from departments hospital-wide were truly remarkable and contributed immensely to producing favorable outcomes along with enhancing collaborative relationships amongst each department.

However, staff on night and weekend shifts were not always comfortable manually proning the most rapidly deteriorating patients. Unlike the weekday day shift – when most manual pronation was performed – providers on night and weekend shifts were drawn from varying specialties from across the hospital, and there was not always adequate available staff to safely perform the task without potential endotracheal tube or central line dislodgements.

At the time of this study being conducted, comparative data were unavailable as published research in this area was scarce, with ever-changing information about the COVID-19 virus and the latest treatment modalities were under constant revision.

Creativity

Due to the nationwide shortage of PPE, we adopted a warzone mentality with creative efforts in order to conserve PPE and minimize staff exposure to the virus. A Controlled Air Purifying Respirator (CAPR) cart and wall were also created, allowing the CAPRs and shields to be grabbed quickly during an emergency. Garbage cans and hand sanitizer stands were placed outside each patient room to enhance staff compliance and comfort. The "PPE Buddies" were beneficial in ensuring all staff were safe to enter each room and played a pivotal role in preventing staff from contracting the virus during the initial surge by monitoring hand hygiene and proper donning/doffing of PPE. Although there is limited data available for the number of healthcare workers who contracted and/or died from COVID-19, it is estimated that 32% of nurses who contracted COVID-19 succumbed to the virus in the United States (Chan et al., 2021). During our study period, there were no nurses who died from COVID-19.

A strict, hospital-wide no-visitor policy meant staff had to find creative ways for families to communicate with their hospitalized loved ones, many of whom could not actively engage with anyone due to being deeply sedated, mechanically ventilated, and oftentimes medically paralyzed. Families frequently delivered photos, drawings, cards, and various mementos to the hospital lobby that were retrieved and displayed in their loved one's room. Some patients' loved ones recorded their voices to have played for the patient. Wrenchingly, these were often words of goodbye.

The care team also had to develop new ways to communicate with patients' families. Robert et al. (2020) recommend proactively scheduling and completing

contact with immediate family members in order to foster a rapport with the patient's loved ones, provide updates on clinical status, ensure the patient's wishes are fulfilled, and communicate the plan of care. At our hospital, the chaplaincy department assisted with scheduling daily video chats between families and the care team on hospital-provided tablets. These video chats allowed ICU intensivists to provide daily updates to family members and allowed families to feel present and included in patient care.

Implications for Clinical Practice

Our results suggest that manual pronation did impact patients' oxygenation and survival during their COVID-19 hospital stay, although we did not have a non-prone comparison group. Strict adherence to infection control measures can maintain quality metric data under new and unfamiliar circumstances. Despite our small, community-based hospital not having resource allocation similar to that of a large urban facility, strong collaboration amongst staff and hospital supply teams was required in order to ensure adequate supplies were ordered and readily available across all shifts. We were able to surpass other institutions in maintaining superb quality metric data and optimizing patients' chances of survival through the implementation of manual pronation for the first time ever at this facility.

Limitations

There are some limitations to this retrospective study. First, the sample size is relatively small. Additionally, this study employed a one-sided design, wherein a non-proned comparison group was not reviewed. Lastly, while explicit inclusion and exclusion criteria for manual pronation can be found in the literature (Mitchell & Seckel, 2018; Bamford et al., 2019), at our hospital, the maneuver was performed based on P/F ratios and provider discretion.

CONCLUSIONS

With the new proning policy in place because of the novel COVID-19 population, our data was consistent with a positive increase in P/F ratios from pre- to post-proning. Many surrounding ICUs had dedicated prone teams; however, our hospital relied on several different interdisciplinary team members to partake in the manual pronation as well as management of proned patients across all shifts. Despite an increased number of mechanical ventilation and central line insertions, there were no upticks in hospital-acquired infections, notably CAUTIs, CLABSIs, and VAP/VAEs, as staff maintained strict adherence to basic practice guideline prevention measures, resulting in our facility's ability to maintain its strong quality metric data similar to that of the pre-pandemic. Additionally, there was only one direct-care staff member who contracted COVID-19 during this study.

Enhanced collaborative relationships were formed with multiple units across

the hospital. Particularly, the ED and PACU RNs played a vital role while being redeployed to the ICU to assist in managing the individualized complex care plans for this new patient population that quickly overwhelmed our hospital beds. Overall, our small but mighty ICU took great pride in our strong interdisciplinary efforts, which contributed to optimizing patient outcomes during unprecedented times. Throughout the surge, the ICU clinical care mindset transformed from endurance to resilience.

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