

International Journal of Nursing and Health Care Science

Research Article

DeMellow JM, et al. J Int J Nurs & Health Car Scie 04: 2022-119

Hospital Acquired Pressure Injuries in Prone Positioning - Is Manual Proning better than using the Rotoprone[®] bed?

Jacquie M DeMellow, PhD RN CCNS CPHQ[#], Teri Kozik, Harbir Dhillon

[#]Dignity Health St Joseph's Medical Center, California, USA

[#]Corresponding author: Jacquie M DeMellow, PhD RN CCNS CPHQ, Dignity Health St Joseph's Medical Center, 1800 N California St, Stockton, California 95204, USA

Submission Date: 11 May, 2022

Accepted Date: 26 May, 2022

Published Online: 31 May, 2022

How to cite this article: DeMellow JM, Kozik T, Dhillon H (2022) Hospital Acquired Pressure Injuries in Prone Positioning - Is Manual Proning better than using the Rotoprone[®] bed? Int J Nurs & Health Car Scie 02(05): 2022-119.

Abstract

Objective: This study compared the incidence of hospital-acquired pressure injuries, between a specialty bed and the manual method of prone therapy in patients with acute respiratory distress syndrome.

Research Methodology/Design: This was a retrospective comparative descriptive study using existing electronic health record data. Patients with hospital-acquired pressure injuries were identified through review of the wound care notes in the electronic health record.

Setting and Sample: The setting was four intensive care units in a 355-bed community hospital in California, USA. The study included 160 adult patients who were placed on prone therapy from July 2019 to January 2021.

Main Outcome Measures: Outcome measures included the development and type of Hospital-Acquired Pressure Injury (HAPI). Data on mortality, hospital length of stay, improvement in oxygenation status, and COVID infection was also abstracted.

Results: During the study period, 160 patients had prone therapy where, 106 (64.2%) were manually proned and 54 were proned using a Rotoprone[®] bed. A total of 50.1% of patients developed HAPI. Chi square analyses showed no association with the incidence of HAPI using manual proning or Rotoprone[®] bed ($p=0.9567$). In patients with COVID-19, 50% developed HAPI compared to 44.4% in non-COVID patients ($p=0.8462$). Deep tissue pressure injuries were the most common type of pressure injury.

Conclusions: There appears to be no advantage using manual versus Rotoprone[®] bed with regard to pressure injury development in patients with prone therapy.

Keywords: Acute respiratory distress syndrome; COVID-19; Intensive care; Pressure injury; Prone positioning

Introduction

Prone positioning is considered standard care for patients in Acute Respiratory Distress Syndrome (ARDS). ARDS manifests as acute inflammation in the lungs causing hypoxia, and in severe cases, carries a mortality of up to 48% [1]. Current standard of care for ARDS consists of mechanical ventilation, limiting tidal volume to <6 mL/kg of ideal body weight and plateau pressure of <30 cmH₂O [2,3]. In patients with moderate to severe ARDS (defined as PaO₂/FiO₂ ratio of <150 mmHg), prone positioning is recommended for over 12 hours per day [4,5]. It is postulated that through prone therapy, the perfusion of the ventral lungs is improved, thereby, improving the oxygenation of the patient [6].

The coronavirus disease 2019 (COVID-19) pandemic has exponentially increased the incidence of ARDS with approximately 28% of COVID patients in the ICU being treated with prone therapy [7]. Although a recent meta-analysis of the use of prone positioning in ARDS found that there was some benefit in decreasing mortality, it was also associated with higher rates of endotracheal tube obstruction and Hospital Acquired Pressure Injury (HAPI) [8]. The literature has shown that up to 57% of patients who had prone positioning developed pressure ulcers [9,10].

These pressure injuries can occur in various locations such as the face, thorax, and trochanter [11,12]. The study of these complications is even more critical given the ongoing COVID-19 pandemic. Placing a patient in the prone position safely is a labor intensive task that requires coordination with a team of staff to prevent dislodgement of lines and tubes as well as mitigation strategies for prevention of HAPI [7,13]. Prone positioning can be achieved using a specialized bed frame that turns the patient automatically or can be done manually using a team of staff to place the patient in and out of the position as ordered [13]. With increased ICU patients requiring prone positioning due to the pandemic, both modalities become necessary due to specialty bed shortages. However, little is known about the impact of either of these methods on the development of HAPI. Prior to the pandemic, the Rotoprone® bed was used exclusively, therefore, we wanted to determine if one modality was superior in preventing HAPI. Our study compared patient outcomes, specifically the development of HAPI, between the Rotoprone® bed and the manual method of prone therapy in patients with ARDS at a community hospital.

Methods

Research Objectives

The objective of our study was to compare the incidence of HAPI between Rotoprone® bed and manual method of prone therapy. Furthermore, the study compared the mortality rates between these two methods of proning and the effect of COVID on HAPI development.

Setting

This was a retrospective cohort of patients being treated for ARDS and receiving prone therapy. The study setting was a 355-bed, not for profit regional hospital in California, specializing in cardiovascular care, women and children's services including Neonatal Intensive Care (NICU), and 24-hour emergency service serving a diverse population. The hospital has four adult ICUs consisting of 39 beds, with 24/7 intensivist coverage. The hospital had 18,095 admissions in 2020 with 1600 being COVID-19 related. This study spanned a period of time in which there were two major surges of the COVID-19 pandemic. Initially, patients requiring prone therapy were placed on Rotoprone® beds which are utilized to facilitate positioning. Due to the increase in demand for these beds during the pandemic, patients were manually proned later due to the inability to source these beds. The hospital uses evidence based protocols for HAPI prevention with prone positioning by Elsevier Incorporated that uses current national guidelines. The protocols include the application of a soft silicone multilayer foam dressing to the face and all bony prominence areas (e.g., shoulders, chest, iliac crest, elbows, tibia). Thin foam dressings are also placed under all medical devices [14]. The protocols were used for all patients regardless of the method of proning. The hospital employs wound care nurses who are responsible for evaluating and staging the wounds according to the National Pressure Injury Advisory Panel (NPIAP) guidelines [15].

Ethical Approval

Institutional Review Board oversight approval was obtained to conduct this study. IRB #: CANV DHIRB-2020-568.

Participants

Adult patients with International Classification of Diseases (ICD) 10 Code for ARDS, ICD 10 Code for COVID-19, and patients who were placed on prone therapy for greater than 24 hours and were admitted to one of four adult ICUs from July 2019 to January 2021. All patients were treated per ARDS protocol similarly except were either proned manually or automatically utilizing the Rotaprone bed. A total of 231 patients were identified according to the criteria above.

Data Collection

Demographic data included age, sex, race/ethnicity, and Body Mass Index (BMI). Clinical factors such as proning method, time spent in prone therapy, use of sedation, paralytic agents, and steroids were abstracted. Risk for mortality was used as a measure of severity of illness, using the Midas® Healthcare Analytics Solutions, risk-adjustment model (<https://www.midasplus.com/Overview.htm>) which risk-adjusts individual patient encounters by assigning probabilities and expected values for mortality, length of stay, readmissions, and complications. Other outcomes were Hospital Length of Stay (HLOS), ICU Length of Stay (ICU LOS), and improvement in oxygenation, defined as a decrease in Positive End Expiration Pressure (PEEP) and FiO₂ within 48 hours after prone therapy was initiated. Patient-level data were retrieved from both Midas® for administrative data (demographic information) and the Cerner EHR system for the clinical variables, such as prone positioning, type of prone, and development of HAPI wound care notes.

Data Analysis

Utilizing 'r' software for analysis, descriptive statistics were calculated for all variables. Frequency tables were obtained for categorical variables, and means and standard deviations were calculated for continuous variables. Chi-square tests were used to determine association between two variables and Two-Sample t-tests were used to determine significant differences between two groups.

Results

Of the 231 patients identified, 164 had prone therapy during the study period where 106 (64.2%) were manually proned and the remaining 54 were proned using a Rotoprone® bed. Four patients had both methods for proning and were removed from the analysis.

Patient Characteristics

As shown in (Table 1), the majority of the patients were male (58.5%), white (38.4%), and non-Hispanic (50.6%). The study group's mean age was 61.08 years and their mean BMI was 32.73. In our sample, the majority of the patients expired (73.2%). In our study, 89% of the patients were diagnosed with COVID-19. The patients spent an average of 14.79 days on the mechanical ventilator and 9.05 days on prone therapy. Patients on manual prone therapy had significantly lower use of neuromuscular blocking agent infusions ($p = .0383$) and spent significantly more days on prone therapy ($p = .0143$) (Table 2).

Demographics	
Age in years, mean (SD)	61.08 (12.73)
Sex, n (%)	
Male	96 (58.54)
Female	68 (41.46)
Race, n (%)	
White	63 (38.41)
Asian	41 (25)
Black	13 (7.93)
Other	40 (24.39)
Unknown	7 (4.27)
Ethnicity, n (%)	
Hispanic	75 (45.73)
Non-Hispanic	83 (50.61)
Unknown	6 (3.66)

Table 1: Patient Characteristics.

Clinical factors	Manual Prone (106)	Rotoprone® (54)	p value
COVID-19 Diagnosis n (%)	106 (100)	36 (66.67)	*
BMI, mean (SD)	32.63 (7.10)	33.18 (7.60)	0.3271
Days on prone, mean (SD)	9.87 (7.95)	7.37 (6.05)	0.0143
Days on MV, mean (SD)	14.18 (11.39)	16.06 (14.43)	0.2038
Steroid Use, n (%)	106 (100)	42 (77.78)	*
Sedation used, n (%)	106 (100)	54 (100)	*
NMB Drip, n (%)	55 (51.89)	38 (70.37)	0.0383
Improvement in PEEP or FiO ₂ within 48 hrs of prone	32 (31.37)	20 (38.46)	0.4842**

Note: * A statistical test is not possible due to the distribution of numbers.
** Missing values for PEEP and FiO₂

Table 2: Clinical Factors.

Patient Outcomes

In our sample, 51.83% of patients that were proned developed HAPI, with 18.9% developing Deep Tissue Pressure Injury (DTPI), and 24% having multiple DTPI. Five percent of patients developed Stage I HAPI, 6.71% Stage II, and 8.54% with Stage III, Stage IV, and unstageable HAPI (Figure 1). Pressure injuries varied in location based on the type of prone therapy (Figure 2). There was no association with the incidence of HAPI using manual (50%) or specialty bed (51%) ($p = .96$). Other types of skin injuries, such as mucosal membrane injury and blisters, were commonly documented with both methods of proning therapy, however, there were 33.3% of blisters documented with Rotoprone therapy compared to 11.3% with manual prone therapy (Figure 3).

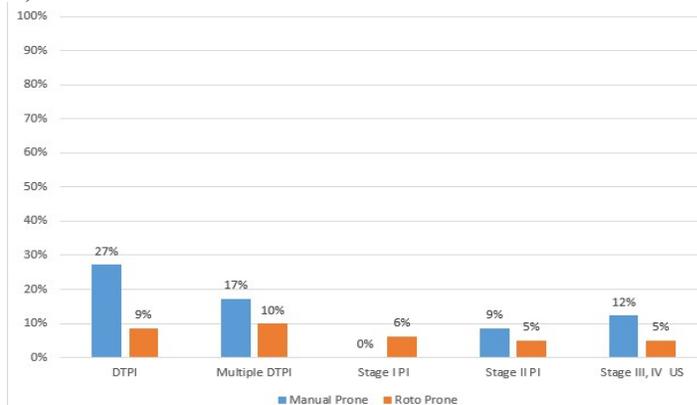


Figure 1: Note: US refers to unstageable pressure injuries, DTPI refers to Deep Tissue Pressure Injury.

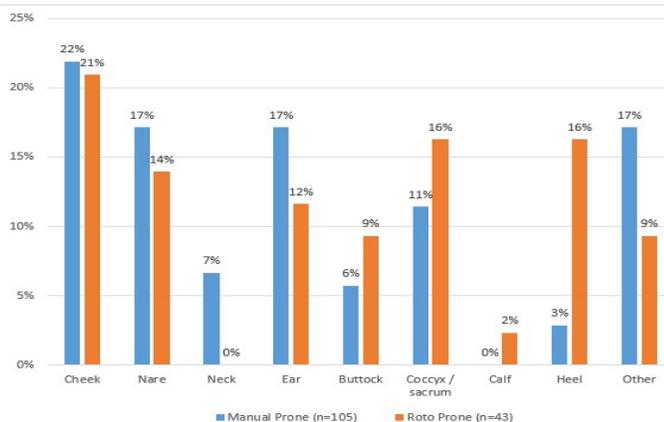


Figure 2: Location of Pressure Injury.

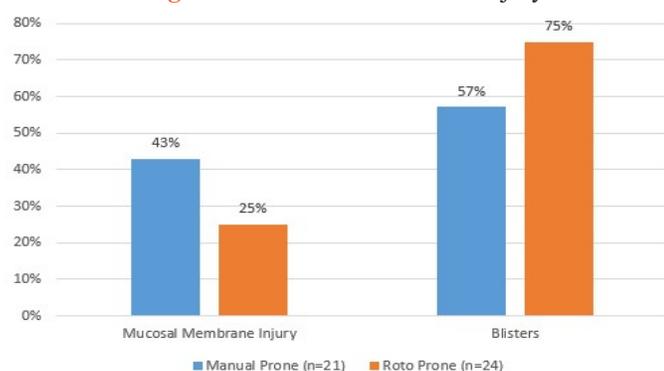


Figure 3: Other Skin Injury.

There was a significant association between the method of prone therapy and mortality. Of the patients who were manually proned, 80.19% died compared to 58.18% of the patients who were placed on the Rotoprone® bed method (p-value = .003). The mortality risk for patients who were manually proned (mean .59, SD .28) was significantly higher than those who were placed on the Rotoprone® bed (mean .49, SD .23) (p = .0156). There were no significant differences between type of prone method and HLOS (p = .380), ICU LOS (p = .209), and improvement in oxygenation (p = .4842) (Tables 2 & 3).

	Manual	Rotoprone®	Statistic
HAPI Incidence n (%)	53/106 (50%)	28/54 (51%)	p = 0.9567
ICU LOS mean (SD)	17.77 (12.96)	17.08 (12.89)	p = 0.2095 95% CI (-6.45, 2.71)
Hospital LOS mean (SD)	23.03 (14.46)	22.78 (14.53)	p = 0.380 95% CI (-5.98, 4.38)
Risk for Mortality mean (SD)	.5862 (0.2858)	.4907 (0.2309)	p = 0.0156 95% CI (0.0087, 0.1824)
Mortality n (%)	85/106 (80.19%)	32/54 (58.18%)	p = 0.003

Table 3: Outcomes.

Association of Factors on Development of HAPI

Using X² analyses, prone therapy was found to be significantly associated with the development of HAPI (53.33%) versus 27.27% in those that were not proned (p = 0.0003). Additionally, having the diagnosis of COVID-19 was not significantly associated with HAPI development, with 50% of patients with COVID developing HAPI compared to 44.4% of non-COVID patients (p = .8462). Using a two-sample t-test, we did not find any differences in BMI between the patients who had HAPI and those who did not (p = .3573).

Discussion

Prone for 12-16 hours per day is the recommended treatment for ARDS patients by The Society of Critical Care Medicine, the American Thoracic Society, and the European Society of Intensive Care Medicine [16-18]. Guérin et.al. [19] demonstrated a reduction in mortality from 33% in a control group of ARDS patients supine only, compared to prone at 16%. However, though prone has become evidenced based practice, other serious complications occur. Our study showed that 51.83% of patients that were proned, developed HAPI which is consistent with other recent studies [9,20]. There was no difference in development of HAPI between the manual and the Rotoprone® bed method of prone therapy. Only one other study with a smaller sample size (n = 37) showed that manual prone was associated with less HAPI than with a Rotoprone® bed (p = .007) [12]. That same study also reported a significant cost savings based on the rental fees for the Rotoprone® bed. We did not see any other significant difference in outcomes using either method of prone, length of stay, oxygenation, or discharge outcome.

Our findings could equip hospitals with the ability to use manual positioning and focus on prevention of HAPI using alternative products with the potential cost savings incurred from rental fees. With supply chain shortages impacting rental beds, manual proning may be the only option however, it requires coordination of staff to turn and reposition patients into swimmers position and put into place preventative devices for HAPI. Several staff are needed for this procedure to safely prone these patients and prevent complications such as accidental extubation and during the pandemic, multiple patients requiring manual proning was not uncommon. Cotton, et.al. [21] found that one strategy to help when manual proning was to have dedicated personnel to for a proning team, alleviating the burden on the primary nurse, decreasing complications to the patient from the procedure itself and injuries to the healthcare team.

Regardless of the method of proning, our study showed a significant amount of facial pressure injuries. Patients developed DTPI most commonly, and device-related injuries were common causing skin breakdown in areas such as the nares and ears. There have recently been studies that have looked at methods of decreasing these types of injuries using prophylactic silicone foam dressings [13,22].

Although our hospital utilized evidence based practices for prevention of HAPI, we still saw high rates of HAPI. It is known that there may be factors that may not be modifiable in patients that are critically ill. These critically ill patients are at higher risk for skin breakdown when they are on hemodialysis, have hypotension, or experience shock states requiring vasopressors [23]. Further, pathophysiological factors also predictive of HAPI development such as impaired tissue oxygenation and perfusion are common in COVID-19 patients [22,24]. Yet, while a higher percentage of patients in our study that developed HAPI had the diagnosis of COVID-19, the latter was not significantly associated with HAPI development. Similar to other studies, [25,26], our study also did not show that BMI was associated with development of HAPI.

We found that there was a significant association between the method of prone therapy and mortality with 80.19% of the patients with manual prone that died compared to 58.18% of the patients with the Rotoprone® bed method. We observed that patients with the manual prone method had a significantly higher risk for mortality than those with Rotoprone® bed, and all the patients that were manually proned had the COVID diagnosis. The COVID infection and its complications may have contributed to the increased mortality observed in these patients. This could be explained by the fact that some of the time period of the study was pre-pandemic when patients were proned using the Rotoprone® bed. With the surge in ARDS cases due to the pandemic, the availability of the Rotoprone® bed decreased and patients were then proned manually in order to continue standard of care therapy.

Overall, this study underscores the importance of wound prevention and early detection and management during prone therapy regardless of the method. Patients are highly susceptible to these wounds when undergoing either manual or specialty bed proning. Consistent, regular wound checks are high yielding in these patients. Repositioning frequently can also help with decreasing the incidence of DTPIs. Utilizing devices such as air fluidized pillows and silicone foam dressings, may be beneficial in prevention [13,27]. Adherence to evidence-based preventative actions can be a challenge to nurses when working under crisis conditions with increased workload during the pandemic surge. Using creative staffing models to support staff at the bedside could mitigate this strain on staffing [21,28].

Limitations

This study has several limitations associated with the nature of the retrospective observational study. This study was restricted to the clinical data available in the EHR. For example, our identification of HAPI was restricted to the wound care nurse notes. Thus, if there was no note entered it is likely that we may have missed developments of wounds. This study did not include factors such as albumin levels to identify malnutrition in these patients or vasopressor use in these patients, both of which have been identified as significant in development of HAPI [29,30].

Conclusion

This retrospective observational study did not find that the method of proning was a factor in the incidence of HAPI. Using a Rotoprone® bed may have advantages with regard to use of manpower to prone and supine patients, however, it can be costly. When manual proning is the only option, there is considerable effort required to coordinate staff for turning and proning patients and utilizing preventative devices to prevent HAPI. Savings from the bed rentals can be used to purchase support surfaces, equipment and devices that can mitigate the development of HAPI.

References

1. Ranieri VM, Rubenfeld GD, Thompson BT, et al. (2012) Acute respiratory distress syndrome: the Berlin Definition. *Jama* 307: 2526-2533.
2. Brower RG, Matthay MA, Morris A, et al. (2000) Ventilation with lower tidal volumes as compared with traditional tidal volumes for acute lung injury and the acute respiratory distress syndrome. *N Engl J Med* 342: 1301-1308.
3. Griffiths MJD, McAuley DF, Perkins GD, et al. (2019) Guidelines on the management of acute respiratory distress syndrome. *BMJ Open Respir Res* 6: e000420.
4. Papazian L, Aubron C, Brochard L, et al. (2019) Formal guidelines: management of acute respiratory distress syndrome. *Ann Intensive Care* 9: 69.

5. Park SY, Kim HJ, Yoo KH, et al. (2015) The efficacy and safety of prone positioning in adults patients with acute respiratory distress syndrome: a meta-analysis of randomized controlled trials. *J Thorac Dis* 7: 356-367.
6. Kallet RH (2015) A Comprehensive Review of Prone Position in ARDS. *Respir Care* 60: 1660-1687.
7. Team V, Team L, Jones A, et al. (2020) Pressure Injury Prevention in COVID-19 Patients with Acute Respiratory Distress Syndrome. *Front Med (Lausanne)* 7: 558696.
8. Munshi L, Del Sorbo L, Adhikari NKJ, et al. (2017) Prone Position for Acute Respiratory Distress Syndrome. A Systematic Review and Meta-Analysis. *Ann Am Thorac Soc* 14(Supplement_4): S280-s288.
9. Girard R, Baboi L, Ayzac L, et al. (2014) The impact of patient positioning on pressure ulcers in patients with severe ARDS: results from a multicentre randomised controlled trial on prone positioning. *Intensive Care Med* 40: 397-403.
10. Lucchini A, Bambi S, Mattiussi E, et al. (2020) Prone Position in Acute Respiratory Distress Syndrome Patients: A Retrospective Analysis of Complications. *Dimens Crit Care Nurs* 39: 39-46.
11. Martel T, Orgill DP (2020) Medical Device-Related Pressure Injuries During the COVID-19 Pandemic. *J Wound Ostomy Continence Nurs* 47: 430-434.
12. Morata L, Sole ML, Guido-Sanz F, et al. (2021) Manual vs Automatic Prone Positioning and Patient Outcomes in Acute Respiratory Distress Syndrome. *Am J Crit Care* 30: 104-112.
13. Capasso V, Snyderman C, Miguel K, et al. (2021) Pressure Injury Development, Mitigation, and Outcomes of Patients Proned for Acute Respiratory Distress Syndrome. *Adv Skin Wound Care* 35: 202-212.
14. *Clinical Skills*. Elsevier, I.
15. Edsberg LE, Black JM, Goldberg M, et al. (2016) Revised National Pressure Ulcer Advisory Panel Pressure Injury Staging System: Revised Pressure Injury Staging System. *J Wound Ostomy Continence Nurs* 43: 585-597.
16. Alhazzani W, Møller MH, Arabi YM, et al. (2020) Surviving sepsis campaign: Guidelines on the management of critically ill adults with coronavirus disease 2019 (COVID-19). *Intensive Care Medicine* 1-34.
17. American Thoracic Society (2020) Diagnosis and management of COVID-19 disease. *American Journal of Respiratory and Critical Care Medicine* 201: 1-4.
18. Mitchell DA, Seckel MA (2018) Acute respiratory distress syndrome and prone positioning. *AACN Advanced Critical Care* 29: 415-425.
19. Guérin C, Reignier J, Richard JC, et al. (2013) Prone positioning in severe acute respiratory distress syndrome. *New England Journal of Medicine* 368: 2159-2168.
20. Ibarra G, Rivera A, Fernandez-Ibarburu B, et al. (2021) Prone position pressure sores in the COVID-19 pandemic: The Madrid experience. *J Plast Reconstr Aesthet Surg* 74: 2141-2148.
21. Cotton S, Zawaydeh Q, LeBlanc S, et al. (2020) Proning during COVID-19: challenges & solutions. *Heart & Lung* 49: 686-687.
22. Peko L, Barakat-Johnson M, Gefen A (2020) Protecting prone positioned patients from facial pressure ulcers using prophylactic dressings: A timely biomechanical analysis in the context of the COVID-19 pandemic. *Int Wound J* 17: 1595-1606.
23. Cox J, Schallom M, Jung C (2020) Identifying Risk Factors for Pressure Injury in Adult Critical Care Patients. *Am J Crit Care* 29: 204-213.
24. Black JM, Berke CT (2020) Deep Tissue Pressure Injuries: Identification, Treatment, and Outcomes Among Critical Care Patients. *Crit Care Nurs Clin North Am* 32: 563-572.
25. Cox J (2017) Pressure Injury Risk Factors in Adult Critical Care Patients: A Review of the Literature. *Ostomy Wound Manage* 63: 30-43.
26. Edsberg LE, Langemo D, Baharestani MM, et al. (2014) Unavoidable pressure injury: state of the science and consensus outcomes. *J Wound Ostomy Continence Nurs* 41: 313-334.
27. Moore Z, Patton D, Avsar P, et al. (2020) Prevention of pressure ulcers among individuals cared for in the prone position: lessons for the COVID-19 emergency. *J Wound Care* 29: 312-320.
28. Jansen L (2020) Building capacity in a pandemic: An alternate staffing model.
29. Midas© Healthcare Analytics Solutions, risk-adjustment model (2020).
30. Pressure Injury Prevention. (2020).