Prone Positioning for Adults with COVID-19 Receiving High Flow Oxygen via Nasal Cannula

A Rapid Review and Snapshot of the Evidence

Clinical Question: What is the quantity, quality, and consistency of the evidence for the use of prone positioning with high flow oxygen via nasal cannula for adult patients with COVID-19 in a non-intensive care unit setting?

Background/History: COVID-19 is a global event requiring a swift healthcare response.[1] Prone positioning (PP) of ventilated patients has been studied for several years.[1,3,6] The positive outcomes of this treatment has led to the creation of COVID-19 management guidelines throughout the international medical community.[1,6] Early studies support the early intervention of prone ventilation for patients with moderate to severe ARDS, as compared to the traditional supine position.[1,3,6] However, to date few studies have been published for PP in non-ARDS patients receiving non-invasive ventilation.[3] Several clinical trials are examining various treatment modalities for SARSCoV2 induced pneumonia.[3,6] Prone positioning as specified in the clinical question above has rapidly evolved since December 2019 and continues to develop as new evidence is published. The citations included in this review have been mentioned in multiple venues such as social media, websites, online/open and/or print journal publications. These citations may be seminal, as they provide the foundation for future research and discussion.

Search Results: The population examined in this review were restricted to hospitalized conscious adult patients with COVID-19 pneumonia in PP and receiving high flow oxygen via nasal cannula in a non-ICU setting. Limited evidence was available for this emerging and urgent clinical topic. This rapid review was then expanded to include the ICU setting and for patients with non-COVID-19 pneumonia. A total of 6 citations were found that pertained to the area of clinical inquiry.[1-6] The final evidence consisted of two commentaries[3,5] (one with embedded case study[3]), one position paper,[1] two case studies,[2,6] and one prospective descriptive cohort study,[4] which limits the generalizability of review findings. Although each citation was ranked between moderate to high, the final appraisal grade for the quality of this early evidence was deemed low due to the lack of rigorous research studies (See Page 11).

Conclusions/Key Summary of the Evidence: Prone positioning was deemed a useful adjunct to current respiratory treatment and management for both COVID[1-3,5] and non-COVID pneumonia[4,6] and early-to-moderate ARDS.[1-6] Although of low quality, the existing evidence consistently reported low risk and high benefits for patients using this treatment modality.[1-6] Conscious patients with COVID-19 respiratory complications may benefit from PP and HFNC/NC oxygenation,[1-6] with possible reductions in mechanical ventilation and resulting mortality.[1-6] Additional studies and resources for this patient population are extremely promising[7-10] and have produced workflow tools such the Lippincott pocket card[9] for PP for adult awake patients receiving NC oxygen (Pages 4-5). The pocket card was developed from the Bamford et al. (2020) position paper[1] and is a significant reference for this review.

One key healthcare professional missing from this conversation was the registered nurse. Only one citation, an expert commentary, outlined the importance of the bedside nurse.[5] The authors described the high work load associated with PP and emphasized that other staff may be needed to successfully implement this time consuming and physically taxing protocol.[5] Important patient care activities such as bowel function, accurate fluid balance, and careful suctioning are also needed.[5] Other key highlights of the evidence include:

- The evidence described the various structures,[1-6] processes,[1-6] and targeted outcomes[1-3,6] required to implement and evaluate PP with HFNC for awake adults with COVID/nonCOVID pneumonia.[1-6] (See Table 1, Page 3).
- When led by an interprofessional team[3,5,6] with nurses,[5] early screening and implementation of science-based treatments can contribute to decreased mortality[3] and other key outcomes for these patients.[2,3,6]
- Independent risk factors were identified as age, lymphocyte count, supplemental oxygen, and lung infiltrates.[3]
- The literature outlined the various outcomes associated patient receiving PP with HFNC/NC and included: screening at-risk people,[3] length of stay,[6] oxygenation status,[2,4,6] airway/secretion management,[1,2,6] lung recruitment,[1] and prevention of alveolar collapse[3] (See Table 1, Page 3).

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(Key Highlights of the Evidence Continued)

- Algorithms and flow diagrams were designed to streamline screening, decision-making, and patient care.[1,3]
- There were no universally accepted positions or turning routines. Other positions besides prone were elevated head of bed 30 to 60 degrees, semi-fowlers, and left/right side lying.[1,2,6]
- There were no universally accepted timing routines. Timing intervals for PP ranged from intervals of 30 minutes,[1] 2 hours,[1] and 4 hours,[6] for a combined total of 6 to 12 hours[2] a day,[1,2,6] and included both dayshift and nightshift[6] for up to 14 days[6] (See Table 1, Page 3).
- No author described documentation related to PP, including timed turns, by any clinician for either paper or electronic healthcare records.

Recommendations: The management of prone positioning with HFNC for awake adult patients will be a topic of debate and care planning for the immediate future.[2] Prone positioning therapy requires all members of the interprofessional to collaboratively develop realistic nurse/patient centric protocols for optimal patient care in the acute hospitalized adult. Investigative studies are promising for this new area of research, as seen by an early PP study in the emergency department.[7] The following recommendations are offered for interprofessional clinicians to consider as they re-examine the questions and options involving this at-risk patient population:

- Investigate the combination of HFNC oxygenation[1,3-6] or nasal cannula 4 liter[2] per minute, with body positioning including prone,[1-6] as determined by continuous screening and assessment[3] (Table 1, Page 3).
- Use an interprofessional approach, clinical reasoning, and appropriate decision-making resources for early screening and treatment of this vulnerable population.[1,3]
- Create and/or customize patient-focused algorithms,[1,2,3] guidelines, and frameworks to determine the optimal timing and turning components needed for clinical efficacy and safe patient/staff outcomes.[1,2,3,6]
    - Consider integrating new workflows into current early warning systems.[3]
- Determine the pertinent documentation features required for a comprehensive picture of care delivery given by nurses and other clinical experts and providers.
- Further investigation[4,6] is needed to improve the low quality of current evidence and include large sample sizes involving multicenter prospective clinical trials in non-intubated patients,[4] as well as the safety and efficacy of this treatment.[6]

Acknowledgements: Additional independent database searches were conducted by three regional medical librarians (Kristyn Gonnerman, San Gabriel Valley & Orange County; Cindy Runnels, Downey and South Bay; Belen Thornfield, Orange County). Article review assistance was provided by members of the Regional Nursing Research Program (Emma Aquino-Maneja; Lina Kawar, June Rondinelli, Regina Valdez).

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Table 1

Structures, Processes, and Outcomes of Prone Positioning with Nasal Cannula Oxygen Delivery for Non-Intubated Conscious Patients

Structures	Processes	Outcomes
Interprofessional Team[3,5,6] • Registered Nurses (RN)[3,5,6] • Physicians[3] • Respiratory Care Practitioners (RCP)[3,6] **Hospitalized Adult Patients[1-6]** • Conscious; not intubated/on ventilator[1-3] • Able to self-prone (preferred) or minimal assistance from staff[4-6] • Must be cooperative[5] **Care Setting[1-6]** • nonICU bed[1-3] vs. *ICU bed[4-6] **Oxygenation Equipment[1-6]** • Oxygen supply[1-6] • High flow nasal cannula:[1-3;5,6] 60 liters per minute[6] • Routine nasal cannula: *4 liters per minute[2] **Positioning Surface[1,6]** • Appropriate bed for proning and additional positions o Elevated head of bed 30-60 degrees[1] o Semi-fowlers[6] o Side-lying[1,6] **Decision Making Tools[1,3]** • Algorithms[3] • Flow Diagrams[1]	**Primary Therapy** • Use clinical reasoning and appropriate decision-making resources for patient screening and treatment[1,3] • Combine high flow nasal cannula oxygen (HFNO)[1,3-6] at 60 liters/FiO2 100%[6] or *nasal cannula 4 liter[2] per minute with body positioning including prone[1-6] **Timed Prone Positioning** Case Study #1 • Morning X 5 days - 4 hours: Arms in a swimmer's position exchanging elevation of left or right arm with head ipsilateral lateralization.[6] Pulmonary physiotherapy given while in prone position.[6] • Dayshift X 5 days - Next 4 hours: Semi-fowlers position.[6] • Afternoon/Nightshift X 5 days: Semi-fowlers; alternate with decubital left or right.[6] • X 9 days: Semi-fowlers with frequent mobilization; continue on HFNO with titrated oxygen reduced to 30%[6] • Day 14: HFNO therapy transitioned to low flow standard oxygen therapy[6] Case Study #2 • 30 min to 2 hours fully prone with bed flat[1] • 30 min to 2 hours right side lying with bed flat[1] • 30 min to 2 hours sitting 30-60 degrees with elevated head of bed (HOB)[1] • 30 min to 2 hours left side lying with bed flat[1] • 30 min to 2 hours fully prone with bed flat[1] • Repeat cycle[1] Case Study #3 • 6 to 8 hours a day on nasal cannula 4 liters per minute.[2] • 12 hours or more the next day[2]	**Screening and Identification of At-Risk Patients[3]** • Early screening of SpO2, RR, HR and early warning model[3] • High-risk patients under continuous close monitoring[3] **Pulmonary Status (based on case studies)[2,3,6]** Significant improvement in: o SaO2/PaO2/oxygenation[2,4,6] o Secretion drainage[1.2.6] after pulmonary physiotherapy[6] o Dysnpea[6] o Posterior lung recruitment[1] o Increased lung volume at end of expiration (LVEE)[3] after alveolar unit recruitment[1,3] o Prevention of alveolar collapse[3] • O2 sat > 95% at rest; 90% with walking after 24 hours[2] • SpO2 + ABG improved with NHFO alone,[6] yet prone positioning with NHFO with improved work of breathing[6] **Length of Stay (LOS)[6]** • *ICU LOS 7 days post-therapy without systemic inflammatory response or organ dysfunction[6] **Risk Factors[3]** • Age, lymphocyte count, supplemental oxygen, and aggressive pulmonary infiltrations were independent risk factors for patients who progress to a critical condition[3]

**Frequently cited articles regarding COVID-19 prone positioning with HFNC or NC*

NOTE: Above information is based on one prospective observational cohort study,[4] two case studies,[2,6] one position paper,[1] and expert opinion[3,5] (one with embedded case study[3]), which limits the generalizability of findings

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May 2020
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Prone Positioning: Non-Intubated Patient with COVID-19 ARDS

Based on the progress made in mechanically ventilated patients, it has been theorized that adopting the prone position for conscious, non-intubated patients with COVID-19 ARDS may help improve oxygenation, reduce the need for invasive ventilation and potentially decrease mortality. The potential physiologic benefits include:

- Improved ventilation (V)/perfusion (Q) matching and reduced hypoxemia
- Reduced shunt
- Recruitment of the posterior lung segments due to reversal of atelectasis
- Improved clearance of secretions

Criteria for Prone Positioning

For the conscious patient who is not receiving mechanical ventilation, consider these criteria for prone positioning:

- Suspected or confirmed COVID-19 infection
- FiO_2 greater than or equal to 28% or requiring basic respiratory support to achieve SaO_2 92 to 96% (88 to 92% if risk of hypercapnic respiratory failure)
- Ability to communicate and cooperate with the procedure
- Ability to rotate to front and adjust position independently
- Absence of anticipated airway issues

Contraindications

Evaluate patient for the following absolute and relative contraindications:

Absolute contraindications

- Respiratory distress
- Immediate need for intubation
- Hemodynamic instability (SBP less than 90 mmHg) or arrhythmia
- Agitation or altered mental status
- Unstable spine/thoracic injury/recent abdominal surgery

Relative Contraindications:

- Facial injury
- Neurological issues (e.g. frequent seizures)
- Morbid obesity
- Pregnancy (2nd/3rd trimesters)
- Pressure injuries

Procedure

1. **Assist patient to prone position.**
   - Explain the procedure.
   - Ensure oxygen therapy and basic respiratory support; make sure there is adequate length of tubing.
   - Use pillows, as needed, to support the chest.

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- Reverse Trendelenburg position may aid comfort.
- Monitor oxygen saturation.
- Don't administer sedation to facilitate prone positioning.

2. **Monitor oxygen saturation for 15 minutes.**
   - Goal is SaO_2 92 to 96%; 88 to 92% if risk of hypercapnic respiratory failure
3. **Continue prone positioning.**
   - Change position every 1 to 2 hours with the goal of keeping the patient prone as long as possible.
     - Use timed position changes; ask the patient to switch positions as follows:
       - 30 minutes to 2 hours lying fully prone (bed flat)
       - 30 minutes to 2 hours lying on right side (bed flat)
       - 30 minutes to 2 hours sitting up (30 to 60 degrees) by adjusting head of the bed
       - 30 minutes to 2 hours lying on left side (bed flat)
       - 30 minutes to 2 hours lying prone again
       - Continue to repeat the cycle.
     - Monitor oxygen saturations 15 minutes after each position change to ensure oxygen saturation has not decreased.
     - Continue to monitor oxygen saturations as per the National Early Warning Score (NEWS).
   - When not prone, position patient supine, upright 30 to 60 degrees.
   - Titrate oxygen therapy according to patient requirements, as ordered.

If prone positioning is not tolerated

If oxygen saturations deteriorate, take the following steps:

- Ensure oxygen is connected to patient.
- Increase FiO_2 (per facility policy or prescriber's order).
- Change patient position; consider return to supine position.
- Escalate to critical care, as appropriate.

Discontinue prone positioning if:

- No improvement is seen with change of position.
- The patient is unable to tolerate position.
- Respiratory rate increases to 35 breaths/minute or higher, the patient tires, or uses accessory muscles.

Reference:

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Additional Resources

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Evidence Search Strategies: A rapid evidence review on the selected clinical question was conducted from May 5th to June 17th, 2020. This snapshot of the literature examined the evidence for the quantity, quality, and consistency of the evidence for the use of prone positioning with high flow oxygen via nasal cannula for adult patients with COVID-19 in the acute care non-ICU setting. The population examined in this review were restricted to hospitalized adult patients with COVID-19 receiving high flow oxygen via nasal cannula. The environmental setting was restricted to the acute care setting.

Search terms were broad and included "prone position*," "self-position*," "oxygenation," "awake proning," "conscious," "COVID-19," and/or "SARS-CO-V2," either alone or in combination. Electronic databases included PubMed, CINAHL, Cochrane Libraries, National Library of Medicine, Clinicaltrials.gov, and the Kaiser Permanente Clinical Library. Searches were individualized for each database for either open year and/or 2000 to 2020. A final informational search was conducted via the web browsers Yahoo and Google Scholar (See Database Search Methodology, Pages 12 and 13).

This review yielded 27 relevant hits after initial de-duplication between databases and were selected for inclusion. 8 additional duplicates were eliminated, with 19 articles remaining. Four rounds of detailed examination of abstracts and full text articles resulted in the elimination of 13 articles, as they did not answer the clinical question, were outside the acute care environment, included healthcare populations other than adults, or focused on concepts other than oxygen delivery via nasal cannula coupled with prone positioning. After expanding the search to include the ICU setting, 6 articles were identified that pertained to the clinical area of inquiry. The articles were ranked using the Academy of Evidence-Based Practice Evidence Leveling System and graded using the Johns Hopkins Evidence Appraisal tools (See Page 11). The final evidence consisted of two commentaries[3,5] (one with embedded case study[3]), one position paper,[1] two case studies,[2,6] and one prospective descriptive cohort study,[4] which limits the generalizability of review findings. Although each citation was ranked between moderate to high, the final appraisal grade for the quality of this early evidence was deemed low quality due to the lack of rigorous research studies.

Evidence Review Results: The current clinical topic of prone positioning of awake patients with HFNC is continuously evolving. The evidence was limited and consisted of one prospective observational cohort study,[4] two case studies,[2,6] one professional organization position paper,[1] one commentary/expert opinion,[5] and one letter to the editor outlining a relevant research study results with an embedded case study.[3] All of the articles included in this review have been mentioned in multiple venues such as social media, websites, online/open and/or print journal publications. These articles may well be considered seminal, as they have laid the foundation for future research and discussion.

There are several limitations to this review beyond the lack of robust clinical trials. One key healthcare professional missing from this conversation is the registered nurse. Only one citation, an expert commentary, outlined the importance of the bedside nurse for this patient care activity.[5] Other limitations include small sample size,[4] single case reports,[2] and an inability to separate the control group from the intervention groups.[3]

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Academy of EBP© Evidence Leveling System (ELS)			
LEVEL	**DESCRIPTION**	**RELEVANT ARTICLES**	**ARTICLE NUMBER**
A	Meta-analysis of multiple large sample or small sample* randomized controlled studies, or meta-synthesis of qualitative studies with results that consistently support a specific action, intervention, or treatment		
B	Well-designed controlled studies, both randomized and nonrandomized, prospective or retrospective studies, and integrative reviews with results that consistently support a specific action, intervention, or treatment		
C	Qualitative studies, descriptive or correlational studies, concept analyses, integrative reviews, systematic reviews, or randomized controlled trials with inconsistent results	1	#4: Prospective observational cohort study
D	Peer-reviewed professional organizational standards, with clinical studies to support recommendations	1	#1: ICS Position Paper
E	Theory-based evidence from expert opinion or multiple case reports, case studies, consensus of experts, and literature reviews	4	#5: Commentary/expert opinion #2: Case study #6: Case study #3: Letter to the editor with details/tables of retrospective study + case study
MA	Manufacturer's recommendation; Anecdotes		
LR	Laws and Regulations (local, state, federal; licensing boards; accreditation bodies, etc.)		
	Total	**6**	

** A large sample has adequate power to detect the observed effect with confidence (as seen in significant Confidence Intervals). A small sample may lack confidence in the power of the desired effect (Polit & Beck, 2008)*

Designed by Emma M. Cuenca and Cecelia L. Crawford, Academy of EBP; ©Kaiser Permanente SCAL Regional Nursing Research Program, May 2011. *Adapted from AACN Evidence Leveling System (2009) and Canadian Medical Association & Centre for Evidence-Based Medicine, Levels of the Evidence (2001)*

Johns Hopkins Evidence-Based Practice Appraisal Tools

High Quality: **#1 (Position paper); #3 (letter to editor/study results); #5 (commentary); #6 (case study) = 4 articles**
(Consistent, generalizable results; sufficient sample size for study design; adequate control; definitive conclusions; consistent recommendations based on comprehensive literature review including thorough reference to scientific evidence **OR** expertise clearly evident; draws definitive conclusions; provides scientific rationale; thought leader in the field.)

Moderate Quality: #2 (case study); #4 (Prospective cohort) = 2 articles
(Reasonably consistent results; sufficient sample size for study design; some control, and fairly definitive conclusions; reasonably consistent recommendations based on fairly comprehensive literature review including references to scientific evidence **OR** expertise appears credible; draws fairly definitive conclusions; provides logical argument for opinions.)

Low Quality: 0 studies = 0 articles
(Little evidence with inconsistent results; insufficient sample size for the study design; conclusions cannot be drawn **OR** expertise is not discernable or is dubious; conclusions cannot be drawn.)

Final Summary Evidence Grade = Low Quality

(Although citations were ranked between moderate-to-high, the final appraisal grade for the quality of the evidence was deemed **low quality due to the lack of rigorous research studies**. The **majority of evidence was commentary (3), case studies (2), with 1 descriptive cohort study)**

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Search Date(s): May 5th to May 10th, 2020

Clinical question: What is the quantity, quality, and consistency of the evidence for the use of prone positioning with high flow oxygen via nasal cannula for adult patients with COVID-19 in the acute care non-ICU setting?

Database	Key Word(s) and/or Controlled Vocabulary Terms #	Total References Identified (hits)	Relevant References	Duplicate Articles	Selected for Review	Excluded	Final Total
PubMed Years: 2010-2020	Prone positioning; self-positioning; oxygenation; respiratory; AND/OR awake proning; COVID-19 OR SARS-CO-V2	33	8	*	8	4	4
CINAHL Years: 2000-2020	Prone position; conscious patient; AND/OR high flow oxygen; nasal cannula	0	0	0	0	0	0
Cochrane Library Years: Open	Prone position; conscious patient; AND/OR high flow oxygen; nasal cannula	0	0	0	0	0	0
KP Clinical Library Years: Open	Prone position; high flow nasal cannula; COVID	23	2	1 Ding	1	1	0
Clinicaltrials.gov Years: Open	Prone position; high flow oxygen	1	1	0	1	1	0
National Library of Medicine Years: Open	Prone position; conscious patient	15	0	0	0	0	0
Google Scholar Years: Open	Prone position; conscious patient	71	4	4 Ding Bamford Dondorf Elkattaway	0	0	0
Google Years: Open	Prone positioning in awake patients with COVID	22	2	2 Ding	0	0	0
Yahoo Years: Open	Prone positioning in awake patients with COVID	40	5	1 Bamford	4	4	0
Articles Context Reference Links	N/A	N/A	5	0	5	3	2
	TOTALS	**205**	**27**	**8**	**19**	**13**	**6**

#Controlled vocabulary (subject terms, MESH terms, tagged terms specific to database)

*Use the first database as the main comparison for subsequent database searches and identifying duplicate articles

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Clinical Question				
Population and/or Patient(s)	**Intervention/Interest Area**	**Comparison Intervention (Often current practice)**	**Outcome**	**Time Period (If Applicable; Optional)**
Non-intubated adults with COVID-19 in a non-ICU setting	• High flow oxygen delivered via nasal cannula • Prone positioning	Critical adult patients in ICU who are intubated and on ventilators	• Improved lung function • Avoidance of intubation and mechanical ventilation • Other outcomes sourced from the evidence	Hospital stay
Final Clinical Question: What is the quantity, quality, and consistency of the evidence for the use of prone positioning with high flow oxygen via nasal cannula for adult patients with COVID-19 in the acute care non-ICU setting?				

Searchable Question
Key Search Terms: prone position*; self-position*; oxygenation; respiratory; awake proning; COVID-19 OR SARS-CO-V2
Inclusion Criteria: Acute care non-ICU setting, adult, high flow oxygen delivery via nasal cannula, non-intubated, prone positioning
Exclusion Criteria: ICU setting, not an adult, not high flow oxygen delivery via nasal cannula, patient on mechanical ventilators/intubated, and not prone positioning.
Limitors (Open year or year ranges, age ranges, and language, etc.): 2019-2020 or open; English
Databases: PubMed; CINAHL; Cochrane Library, KP Clinical Library, Clinicaltrials.gov, National Library of Medicine
Web Browsers: Yahoo; Google Scholar

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Purpose/intended Audience

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