



# MICU Critical Care RN Titration of FiO<sub>2</sub>

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## Aim Statement:

The goal of this Quality Improvement Project is to reduce ventilated MICU patient overexposure to hyperoxygenation through RN titration of FiO<sub>2</sub>

## Introduction

Hyperoxia can cause alveolar injury, pulmonary edema and a systemic inflammatory response<sup>1</sup>. Excessive oxygen supplementation in mechanically ventilated patients with acute lung injury may worsen lung function<sup>2,3</sup>. Hyperoxia has been associated with increased mortality in patients with stroke, traumatic brain injury and cardiac arrest<sup>1,3</sup>.

While clinicians (ICU RNs and Critical Care Physicians) readily accept the potential harms associated with hyperoxygenation, there is considerable discrepancy in their faithfulness to this delivery method<sup>4</sup>. This discrepancy can be mediated with the development of conservative oxygen therapy protocols and Critical Care Nursing education<sup>5</sup>.

## Intervention:

Critical Care RNs received education regarding the deleterious effects of hyperoxygenation from a second year Critical Care Medicine Fellow during the months of February and March 2019. Formal educational sessions took place at semi-annual MICU RN education sessions, with informal sessions happening during departmental shift change meetings. RNs were then encouraged to titrate patient FiO<sub>2</sub> levels using a prescribed protocol.

## Titration Protocol:

If a ventilated patient is on greater than 50% FiO<sub>2</sub> -

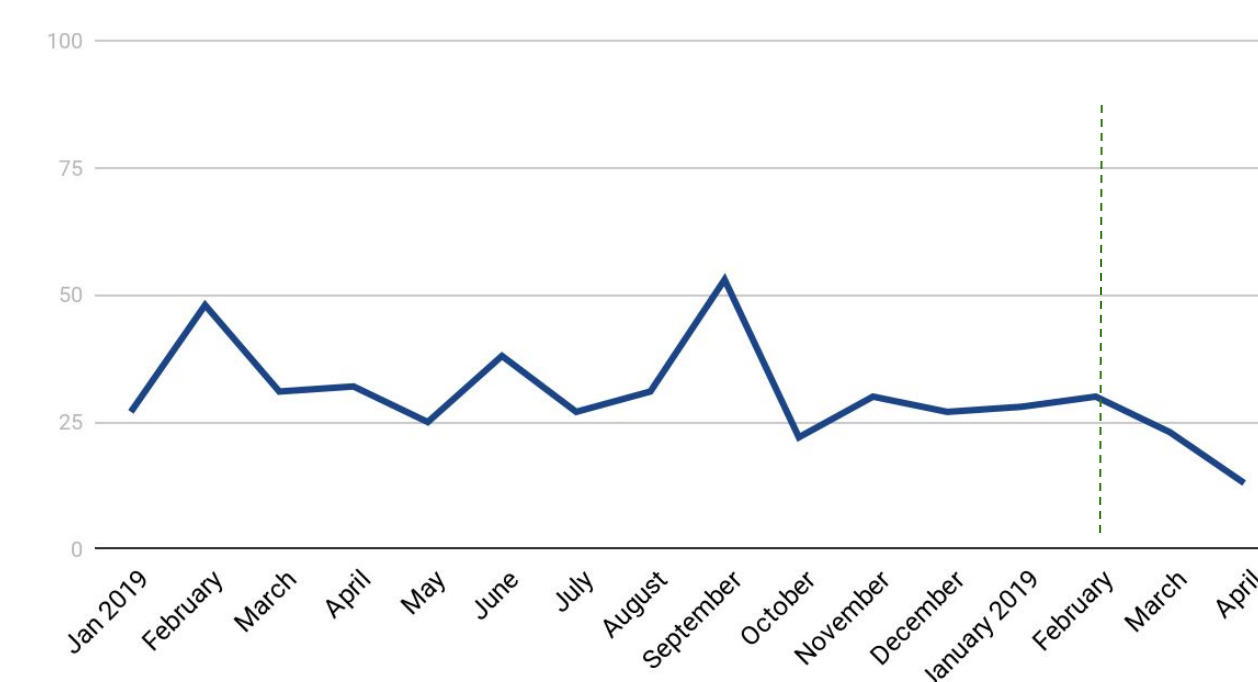
And her/his saturations are greater than 95% -

Please turn down the FiO<sub>2</sub> in increments of 5% or 10% until saturations are between 90% and 95% OR the FiO<sub>2</sub> is 49% or less.

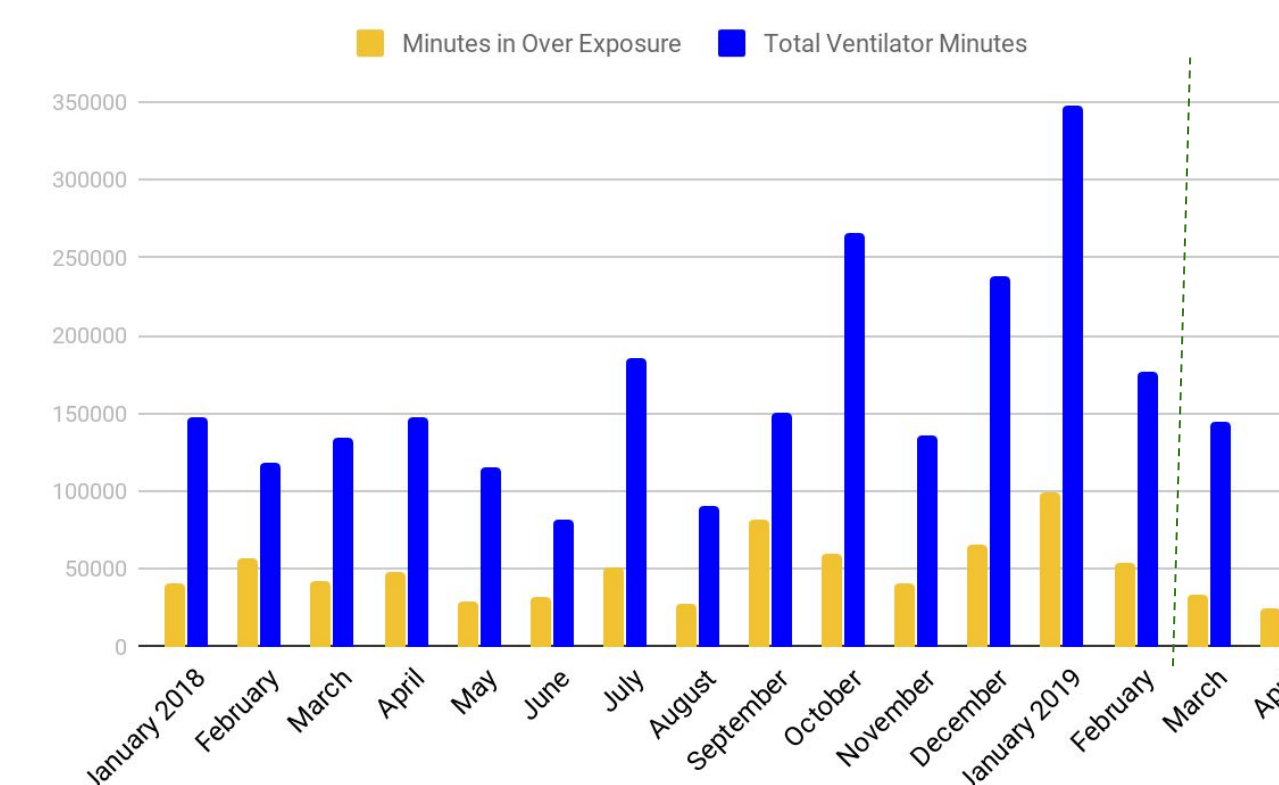
## Measurement:

FiO<sub>2</sub> and SpO<sub>2</sub> levels were collected from the EMR for the calendar year predating the study intervention and for 2 months post-intervention using Structured Query Language. Over exposure minutes were calculated as sum of the minutes between an O<sub>2</sub> reading >90 and a FiO<sub>2</sub> setting > 50 until the next O<sub>2</sub> reading.

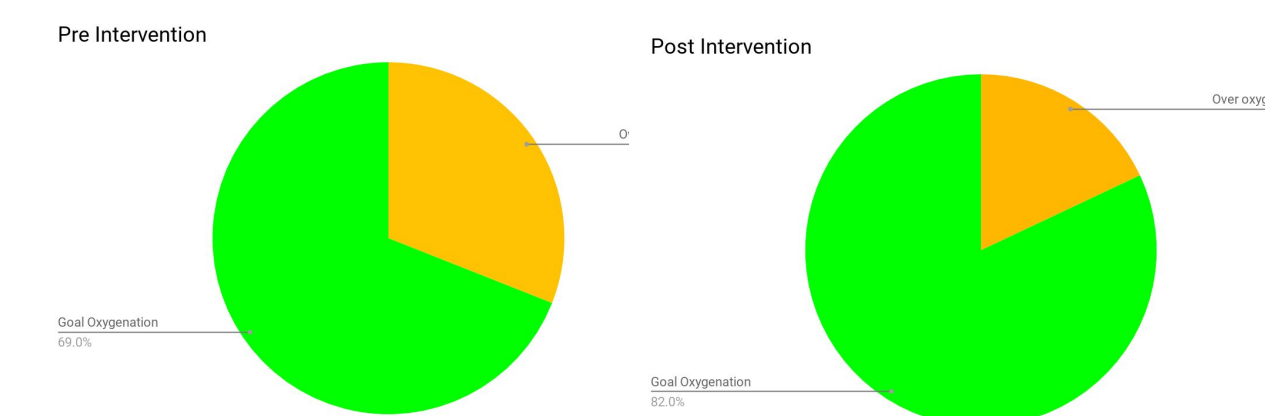
Percent of Time in Over Exposure



**Figure 1.** Percent of time spent with over exposure to oxygenation. Intervention time point indicated by dashed vertical line.



**Figure 2.** Total number of ventilator minutes versus minutes in over exposure, with intervention time point indicated by dashed vertical line.



**Figure 3.** Comparison of averaged percent time overexposure before and after intervention

## Hyperoxygenation Results:

- Pre-intervention: 31.0%
- Post-intervention: 18.0%.

## Discussion and future direction

These results indicate Critical Care Nursing education can influence delivered FiO<sub>2</sub>.

The RN FiO<sub>2</sub> titration policy will need to be further codified to ensure durability of its initial success. This will be accomplished through creation of an FiO<sub>2</sub> titration EMR order set packaged with the MICU Admission Navigator, as well as with annual and orientation MICU RN education.

Portability of the project will be evaluated by bringing the project to the Hennepin County Surgical Intensive Care Unit, and then to the University of Minnesota.

## References

- Pannu, Sonal R. "Too Much Oxygen: Hyperoxia and Oxygen Management in Mechanically Ventilated Patients." *Seminars in Respiratory and Critical Care Medicine*, U.S. National Library of Medicine, Feb. 2016. [www.ncbi.nlm.nih.gov/pubmed/26820270](http://www.ncbi.nlm.nih.gov/pubmed/26820270).
- Rachmale, Sonal, et al. "Practice of Excessive FIO2 and Effect on Pulmonary Outcomes in Mechanically Ventilated Patients With Acute Lung Injury." *American Association for Respiratory Care*, Respiratory Care, 1 Nov. 2012. [rcjournal.com/content/57/11/1887.full](http://rcjournal.com/content/57/11/1887.full).
- Elisa Damiani, et al. "Arterial Hyperoxia and Mortality in Critically Ill Patients: a Systematic Review and Meta-Analysis." *Critical Care*, BioMed Central, 23 Dec. 2014. [ccforum.biomedcentral.com/articles/10.1186/s13054-014-0711-x](http://ccforum.biomedcentral.com/articles/10.1186/s13054-014-0711-x).
- Helmerhorst, Hendrik Jf, et al. "Self-Reported Attitudes versus Actual Practice of Oxygen Therapy by ICU Physicians and Nurses." *Annals of Intensive Care*, Springer, 25 July 2014. [www.ncbi.nlm.nih.gov/pmc/articles/PMC4240734/](http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4240734/).
- Eastwood, Glenn M. et al. "Critical care nurses' opinion and self-reported practice of oxygen therapy: A survey." *Australian Critical Care*, Volume 25, Issue 1, 23 - 30.