

# Sedation Practices in the PICU: An Unexpected Casualty of COVID-19

**ABSTRACT:** Pediatric intensivists often use an “analgo-sedation” approach in mechanically ventilated children. By prioritizing analgesia and minimizing sedation, patients experience less delirium. However, when COVID-19 surged, our pediatric intensive care unit providers were tasked with caring for adults with severe acute hypoxemic respiratory failure (AHRF). As documented in the literature, adults with COVID-19-AHRF received significantly higher doses of sedatives than matched cohorts with non-COVID-19 AHRF. Surprisingly, when the pediatric intensive care unit returned to caring for children, a quality review showed that we were unintentionally using far more sedatives than that prior to COVID-19. This experience is not unique to our institution, or to COVID-19. Lingering effects of crisis care can persist beyond the event itself. We seek to share our experience in order to extend the conversation regarding the unexpected effects of crises on best practices and to stress the need for high-quality research on interventions to support mental health and resilience in frontline healthcare providers.

Katherine Pumphrey, MD<sup>1</sup>

Alisha Bouzaher, MD<sup>2</sup>

Barbara-Jo Achuff, MD<sup>3</sup>

Chani Traube, MD<sup>4</sup>

## To the Editor:

With increasing awareness as to the negative effects of sedating medications, there has been a paradigm shift within the pediatric critical care community over the past decade. Sedative drugs, particularly in the benzodiazepine class, have been strongly associated with delirium and increased hospital length of stay (1). Numerous studies have shown feasibility of alternative sedation regimens, and many PICUs have embraced an “analgo-sedation” approach. Analgo-sedation refers to an analgesic-first approach to sedating patients on mechanical ventilation, prioritizing optimization of pain control, and minimizing the use of sedatives. Analgo-sedation has been shown to be feasible, safe, and effective for the care of mechanically ventilated children (2).

Our team works in an urban academic PICU that was an early adopter of analgo-sedation. Our PICU prioritizes keeping children as awake as possible, even while mechanically ventilated. We accomplish this by minimizing the use of benzodiazepines, avoiding restraints, and maximizing family involvement. Over a 2-year period, we were able to demonstrate a dramatic decrease in opiate use, benzodiazepine use, and delirium rates, with no increase in adverse events (3, 4).

In March 2020, the COVID-19 pandemic overwhelmed our city. We rapidly transformed our PICU into a medical ICU, and for a 3-month period, our PICU doctors and nurses exclusively cared for critically ill adults with severe acute respiratory distress syndrome (ARDS), all of whom required invasive mechanical ventilation (IMV) (5). As has been widely reported in the COVID-19 literature, adult COVID-19 patients received significantly higher dosing of sedatives (with an associated increase in coma and delirium days), when compared with retrospective cohorts of matched patients with similar degrees of ARDS (6).

Copyright © 2022 The Authors. Published by Wolters Kluwer Health, Inc. on behalf of the Society of Critical Care Medicine. This is an open-access article distributed under the terms of the Creative Commons Attribution-Non Commercial-No Derivatives License 4.0 (CCBY-NC-ND), where it is permissible to download and share the work provided it is properly cited. The work cannot be changed in any way or used commercially without permission from the journal.

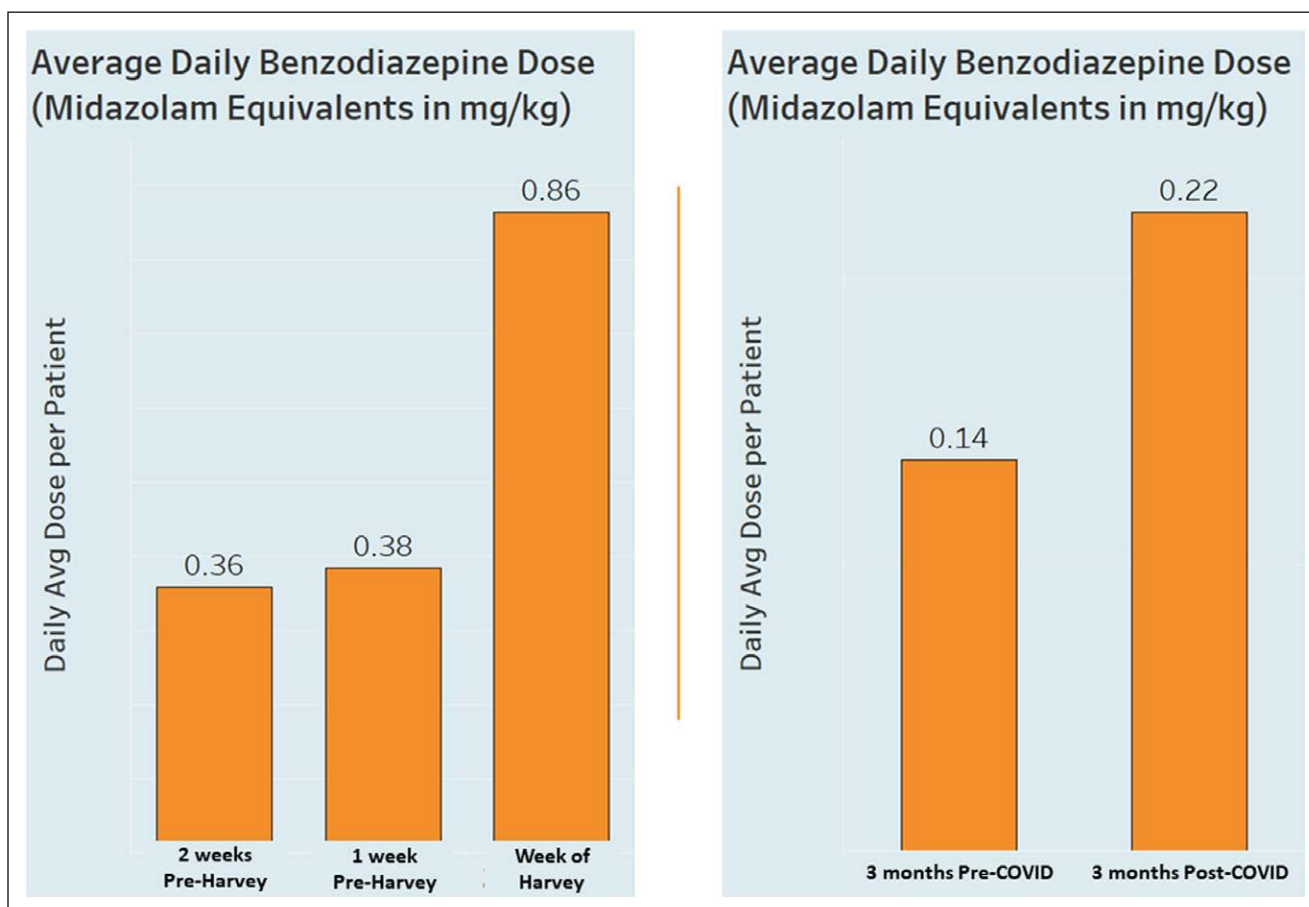
DOI: 10.1097/CCE.0000000000000713

The reason for increased sedation use in COVID-19 patients was multifactorial and not simply a function of severity of illness. It likely reflects the challenges posed by a surge that strained hospital capacity. Nursing staff was spread thin, no family members were allowed, and personal protective equipment—in short supply—was required for every patient encounter. Staff feared for their own health when interacting with COVID-19 patients. With decreased presence at the bedside, there was less ability to interact with the patients. Bedside staff were forced to turn to physical and pharmacological restraints (i.e., sedatives) to keep the patients safe (6).

By June, the COVID-19 surge had abated somewhat in our city, and we were able to return to pediatric critical care. Our assumption was that we were back to “business as usual,” but at our 3-month quality check, we were surprised to note that there had been a substantial increase in our benzodiazepine use in children on IMV (**Fig. 1**). Of note, none of these children had COVID-19, and there were no significant

differences with respect to demographics or severity of illness when compared with the children on IMV pre-COVID-19. There was an associated increase in delirium rates and duration in this cohort (from pre-COVID-19 average of 10% for delirium lasting > 1 d, to 38.5% post-COVID-19;  $p = 0.028$ ).

As part of our quality process, we examined root causes for this change in practice. Our multidisciplinary team identified several possible contributors. One cause was thought to be lack of family presence at bedside. Due to the ongoing pandemic, the hospital still had severely restricted visitation policies. Without parents consistently present to provide emotional support to the child, the nurses were relying more heavily on sedation. A second cause was the need for personal protective equipment when interacting with all patients. This proved to be a disincentive to entering patients’ rooms, again leading to sedative boluses when patient interaction might have been employed in the past. Finally, and most poignantly, when interviewing



**Figure 1.** Sedation exposure in the pediatric intensive care unit. Total cumulative benzodiazepine dose (converted into midazolam equivalents in mg/kg per patient per day) in mechanically ventilated children increased ~2 sd above daily average during the week of Hurricane Harvey (**A**) and for the months in the aftermath of COVID-19 (**B**).

the bedside providers, we realized the magnitude of residual trauma affecting our staff. We were tired and stressed, and unintentionally turning more readily to sedative use for our patients (7).

This is not an experience unique to COVID-19. Pediatric intensivists in Houston noted a similar phenomenon during hurricane Harvey in August 2017. Due to excessive flooding and citywide evacuations, the pediatric cardiac ICU providers were required to stay on-site as part of a disaster response. The unit was short-staffed, and bedside providers were anxious about their personal safety and families' well-being. During the hurricane's aftermath, patients in the cardiac ICU were observed to receive more boluses and higher dose-exposure of sedating medication, especially benzodiazepines (Fig. 1). Retrospective review of the electronic medical record, as part of an ongoing quality assurance (QA) process, showed that weekly average dose of morphine equivalents was 3.5 morphine equivalents in mg/kg prior to the hurricane and 6.75 morphine equivalents in mg/kg afterward ( $>1$  SD above usual). Similarly, weekly average of diazepam equivalents was 6.71 diazepam equivalents in mg/kg prior to the hurricane and 15.1 diazepam equivalents in mg/kg afterward ( $>2.5$  SD above usual). Prehurricane, the average number of midazolam doses per patient per week was 17; posthurricane, it had increased to 24 ( $p = 0.001$ ).

These events remind us of the importance of frequent examination of practices to maintain quality improvement. Ongoing QA processes ensured that we noted this unintentional change in sedation practice within a matter of weeks and were able to intervene effectively. Implementation science has taught us that ongoing data collection is essential to ensure that quality indicators are maintained. Timely feedback—incorporating recent patient data—allows for effective intervention. An attentive, multidisciplinary, and nimble approach is required to sustain quality improvement (8).

Most importantly, this experience has taught us that our bedside staff need ongoing support in the wake of COVID-19. Evidence from prior epidemics demonstrate that frontline providers are at risk of developing problems with long-term mental health (9). This not just affects the healthcare provider but also may have downstream impact on patient care (10). Supportive interventions after resolution of the epidemic (including rotation of workers from high-stress to low-stress tasks, providing easy and confidential access

to mental health services and flexibility in work-shift scheduling) may be helpful. There is an urgent need for high-quality research to determine the effectiveness of these and other interventions to support the mental health and resilience of frontline healthcare providers after a pandemic or natural disaster (9). Even with the worst behind us, the lingering effects persist. This may have unintended consequences on provider practice, specifically with administration of sedative medications.

In conclusion, we suggest that COVID-19 and other natural disasters may increase the frequency and exposure to benzodiazepine and other sedative medications in critically ill pediatric patients, and provider stress may contribute to this difference. We share our perspective as a cautionary tale: the COVID-19 pandemic may have unexpected effects on pediatric analgo-sedation practices. Vigilance is required to ensure that we provide our bedside caregivers with the support necessary so that they can continue to provide evidence-based care, even under extraordinary circumstances.

---

1 Department of Pediatrics, Children's Hospital of Philadelphia, Philadelphia, PA

2 Department of Pediatrics, NY Presbyterian Hospital, Weill Cornell Medical College, New York, NY

3 Department of Pediatrics, Cardiac Critical Care, Baylor College of Medicine, Texas Children's Hospital, Houston, TX

4 Department of Pediatrics, Critical Care Medicine, Weill Cornell Medical College, New York, NY

This work was performed at Weill Cornell Medical College, New York Presbyterian Hospital, and Baylor College of Medicine, Texas Children's Hospital.

The authors have disclosed that they do not have any potential conflicts of interest.

---

## REFERENCES

1. Mody K, Kaur S, Mauer EA, et al: Benzodiazepines and Development of Delirium in Critically Ill Children: Estimating the Causal Effect. *Crit Care Med* 2018; 46:1486–1491
2. Deeter KH, King MA, Ridling D, et al: Successful Implementation of a Pediatric Sedation Protocol for Mechanically Ventilated Patients. *Crit Care Med* 2011; 39:683–688
3. Traube C, Silver G, Kearney J, et al: Cornell Assessment of Pediatric Delirium: A valid, rapid, observational tool for screening delirium in the PICU\*. *Crit Care Med* 2014; 42:656–663
4. Traube C, Silver G, Gerber LM, et al: Delirium and Mortality in Critically Ill Children: Epidemiology and Outcomes of Pediatric Delirium. *Crit Care Med* 2017; 45:891–898

5. Wasserman E, Toal M, Nellis ME, et al: Rapid Transition of a PICU Space and Staff to Adult Coronavirus Disease 2019 ICU Care. *Pediatr Crit Care Med* 2021; 22:50–55
6. Wongtangman K, Santer P, Wachtendorf LJ, et al: Association of Sedation, Coma, and in-hospital Mortality in Mechanically Ventilated Patients with Coronavirus Disease 2019–related Acute Respiratory Distress Syndrome: A retrospective cohort study. *Crit Care Med* 2021; 49:1524–1534
7. Kok N, van Gurp J, Teerenstra S, et al: Coronavirus Disease 2019 Immediately Increases Burnout Symptoms in ICU Professionals: A longitudinal cohort study. *Crit Care Med* 2021; 49:419–427
8. Curtis JR, Cook DJ, Wall RJ, et al: Intensive Care Unit Quality Improvement: A “how-to” guide for the interdisciplinary team. *Crit Care Med* 2006; 34:211–218
9. Pollock A, Campbell P, Cheyne J, et al: Interventions to Support the Resilience and Mental Health of Frontline Health and Social Care Professionals During and After a Disease Outbreak, Epidemic or Pandemic: A mixed methods systematic review. *Cochrane Database Syst Rev* 2020; 11:CD013779
10. Ezzat A, Li Y, Holt J, et al: The Global Mental Health Burden of COVID-19 on Critical Care Staff. *Br J Nurs* 2021; 30:634–642