SASM

Society of Anesthesia and Sleep Medicine

# SASM 2021 *Virtual* Annual Meeting Syllabus

## *Sleep Health: The New Vital Sign*


## October 7-8, 2021

**#SASM21**
**#TheNewVitalSign**

**Program Co-Chairs:**
Mandeep Singh, MD, University of Toronto
Christine Won, MD, MSc, Yale University

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# WELCOME

Welcome to the Society of Anesthesia and Sleep Medicine (SASM) 11th Virtual Annual Meeting: *Sleep Health: The New Vital Sign*!

As we move to the next decade, SASM is positioned as a young and active academic society ready to inspire future and current learners in Anesthesiology, Perioperative Medicine and Sleep Medicine. We are glad to have you join us as we explore new ideas, improve patient care and safety, and advance the field of perioperative sleep medicine. SASM is a collaborative society that works successfully with other academic societies in the anesthesiology, sleep and pain medicine areas.

This year, we propose Sleep Health as the new vital sign, and have a phenomenal line-up of international faculty, with a focus on one and one thing only: Sleep Health!

**Highlights of the meeting include:**

- Keynote speakers:
  - » **Sleep Health and Why We Should be Focusing on it in This Decade**
    *Kannan Ramar, MBBS, MD*
  - » **Sleep and the Pandemic**
    *Meir Kryger, MD, FRCPC*
- Exciting sessions on:
  - » Sleep Health Implications in the Perioperative Setting
  - » Sleep Health: Health Care Workers
  - » Fresh Out of the Oven: SASM Guidelines on Postoperative and OB Management of Patients with OSA
  - » Award-Winning Abstracts and much more!
- Lots of great opportunities to network and collaborate with colleagues from anesthesiology, sleep and pain medicine societies!

We hope you enjoy the meeting!

**Mandeep Singh, MD**
Co-Chair, SASM Conference Committee

**Christine Won, MD, MSc**
Co-Chair, SASM Conference Committee

**Satya Krishna Ramachandran, MD**

**Bhargavi Gali, MD**

**Dennis Auckley, MD**

**Toby Weingarten, MD**

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# KEYNOTE SPEAKERS

**Thursday, October 7, 2021 | 1600-1645**

**Keynote: Sleep Health and Why we Should be Focusing on it in This Decade**
***Kannan Ramar, MD | Mayo Clinic***

Dr. Kannan Ramar is a Professor of Medicine in the division of Pulmonary and Critical Care Medicine (PCCM), Mayo Clinic, Rochester, MN. He is the Chief Safety Officer for Mayo Clinic and serves as the Assistant Dean for Clinical Learning Environment Optimization at the Mayo Clinic School of Graduate Medical Education. He is the Immediate Past President of the American Academy of Sleep Medicine (AASM) and is the President of the Associated Professional Sleep Societies (APSS) from 2021-22. Dr. Ramar served as the Education Chair and as the Program Director for the PCCM, Critical Care Internal Medicine, and Pulmonary Disease Fellowship programs at Rochester, MN.

Dr. Ramar serves as the chair of Mayo Clinic Patient Safety Subcommittee, serves on Graduate Medical Education Committee, Mayo Clinic Proceedings Editorial Board as the Pulmonary Medicine Section Editor, and on the Board of Directors of the AASM. Dr. Ramar has served as the Mayo Quality Fellows Program Chair between 2015 and 2019.

He is board-certified in Critical Care Medicine, Pulmonary Disease, and Sleep Medicine and is the recipient of many notable awards, including Teacher of the Year by the Mayo Fellows' Association 2015, Teacher of the Year 2013 for Inpatient Education, and the MCSGME Program Director Recognition Award 2018-2019. He is Bronze, Silver, and Gold certified.

**Friday, October 8, 2021 | 1045-1130**

**Keynote: Sleep and the Pandemic**
***Meir Kryger, MD | Yale University***

Dr. Meir Kryger, a professor at Yale has been treating patients with sleep disorders for over 40 years. He described the first case of sleep apnea in North America. He is Chief Editor of *The Principles and Practice of Sleep Medicine*, and the *Atlas of Clinical Sleep Medicine*. He has published more than 200 peer reviewed articles. His book, The *Mystery of Sleep*, was featured in an article in The New Yorker, and *Sleep in Art*, explores how artists look at sleep. He recently published a novel, *The Man Who Couldn't Stay Awake*. He has been President of the Canadian Sleep Society and the American Academy of Sleep Medicine, and Chair of the National Sleep Foundation. He has received a Lifetime Achievement Award from the Canadian Sleep Society and the National Sleep Foundation. He has been on BBC radio many times and has appeared on CNN, Good Morning America, and has been interviewed by print media including NY Times and Readers Digest. He teaches the course *Mystery of Sleep* at Yale. He was the main speaker of the Sleep Revolution event sponsored by Arianna Huffington held at Yale in April 2016.

# ACCREDITATION INFORMATION

## PROGRAM OBJECTIVE

The objective of this meeting is to provide a forum for discussions pertaining to the common grounds between sleep and anesthesia. The goal is to promote excellence in medical care, research and education in anesthesia, sleep medicine and perioperative medicine.

## TARGET AUDIENCE

This conference is designed for anesthesiologists, critical care physicians, residents, fellows-in-training, general medicine physicians, pulmonary physicians, sleep medicine physicians, surgeons, scientists and allied health care professionals.

## PRACTICE GAPS

The overall goal of SASM is to advance standards of care for clinical problems shared by anesthesiology and sleep medicine, including perioperative management of sleep disordered breathing (SDB), and to promote interdisciplinary communication, education and research in matters common to anesthesia and sleep.

To identify and address present clinical practice gaps, we propose to explore the following gaps existing today in care of patients with sleep- disordered breathing:

Sleep health disruptions have been associated with a multitude of adverse outcomes, including impacts on cardiovascular, neurological, and mental health as well as quality of life. These disruptions have been exacerbated by the pandemic, and have significantly affected vulnerable populations, which includes health care workers and surgical patients. It is important for the perioperative health care work force to understand sleep health domains, measurement, and interventions that target sleep health to improve outcomes in all the above-mentioned domains.

Emerging literature has explored the relationship between sleep health disruption and meaningful clinical outcomes, including patient-reported outcomes. However, there is a general lack of understanding regarding the significance of sleep health amongst health care providers, as well as the perioperative providers. Moreover, the integration of sleep health assessments into regular history and physical examination is lacking.

In this meeting, panelists will present the current state of the literature, and inform the audience about sleep health domains, their interactions with health and well-being, and meaningful clinical and patient-reported outcomes. Attendees will be able to explore new ideas, improve patient care and safety, and advance the field of perioperative sleep medicine.

## LEARNING OBJECTIVES

1. Discuss new ideas, improve patient care and safety, and advance the field of perioperative sleep medicine.

## SATISFACTORY COMPLETION

Learners must complete an evaluation form to receive a certificate of completion. Your chosen sessions must be attended in their entirety. Partial credit of individual sessions is not available. If you are seeking continuing education credit for a specialty not listed below, it is your responsibility to contact your licensing/certification board to determine course eligibility for your licensing/certification requirement.

## ACCREDITATION STATEMENT

In support of improving patient care, this activity has been planned and implemented by Amedco LLC and Society of Anesthesia and Sleep Medicine. Amedco LLC is jointly accredited by the Accreditation Council for Continuing Medical Education (ACCME), the Accreditation Council for Pharmacy Education (ACPE), and the American Nurses Credentialing Center (ANCC), to provide continuing education for the healthcare team.

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## PHYSICIANS (ACCME) CREDIT DESIGNATION

Amedco LLC designates this live virtual activity for a maximum of **5.75 *AMA PRA Category 1 Credits*™**. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

## DISCLOSURE OF CONFLICT OF INTEREST

The following table of disclosure information is provided to learners and contains the relevant financial relationships that each individual in a position to control the content disclosed to Amedco. All of these relationships were treated as a conflict of interest, and have been resolved. (C7 SCS 6.1---6.2, 6.5)

All individuals in a position to control the content of CE are listed in the agenda. If their name is <u>not</u> listed below, they disclosed that they had no financial relationships with a commercial interest.

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| **Meir** | **Kryger** | Bodimetrics: Consultant<br>Fisher Wallace: Consultant |
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| **Tracey** | **Sletten** | Vanda Pharmaceuticals: Consultant |
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# VIRTUAL MEETING SCHEDULE OF EVENTS

| THURSDAY, OCTOBER 7, 2021 | |
|---|---|
| **Day 1 Central Standard Time: 2:00pm – 4:45pm CST** | |
| **Day 1 Eastern Standard Time: 3:00pm – 5:45pm EST** | |
| **1400 – 1415** | **Welcome Address & Announcements**<br>**Moderator:** ***Satya Krishna Ramachandran, MD, Mandeep Singh, MD*** |
| **1415 – 1530**<br>**2:15 – 3:30 pm CST**<br>**3:15 – 4:30pm EST** | **Session One: Sleep Health Implications for the Perioperative Period**<br>Moderator: Dennis Auckley, MD |
| → **1415 – 1435** | **The Neural Circuits Underlying General Anesthesia and Sleep -** *Olivia Moody, PhD* |
| → **1435 – 1455** | **Postoperative Complications in Obstructive Sleep Apnea: Importance of Phenotypes -**<br>*Thomas Altree, MBBS, FRACP* |
| → **1455 – 1515** | **Sleep Loss in the Hospitalized Patient -** *David Hillman, MBBS, FANZCA* |
| → **1515 – 1530** | **Panel Discussion** |
| **1530 – 1600** | **Break with Exhibitors** |
| **1600 – 1645**<br>***4:00 – 4:45 pm CST***<br>***5:00 – 5:45pm EST*** | **KEYNOTE: Sleep Health and Why we Should be Focusing on it in This Decade -** *Kannan Ramar, MD*<br>**Moderator:** *Bhargavi Gali, MD* |
| **1645** | **Meeting Day 1 Adjournment** |

| FRIDAY, OCTOBER 8, 2021 | |
|---|---|
| **Day 2 Central Standard Time: 9:00am – 2:45pm CST** | |
| **Day 2 Eastern Standard Time: 10:00am – 3:45pm EST** | |
| **0900** | **Announcements**<br>**Moderator:** Mandeep Singh, MD |
| **0900 – 1015**<br>***9:00 – 10:15am CST***<br>***10:00 – 11:15am EST*** | **Session Two: Sleep Health: Health Care Workers**<br>**Moderator:** *Mandeep Singh, MD* |
| → **0900 – 0920** | **Effect of Inadequate Sleep on Clinician Performance -** *Haleh Saadat, MD, FAAP* |
| → **0920 – 0945** | **Optimal Sleep Health for Optimal Resilience -** *Mamta Gautam, MD, MBA* |
| → **0945 – 1005** | **Shift Work: Implications and Interventions for Sleep, Alertness and Performance -**<br>*Tracey Sletten, BSc (Hons), PhD* |
| → **1005 – 1015** | **Panel Discussion** |
| **1015 – 1045** | **Break with Exhibitors** |
| **1045 – 1130**<br>***10:45 – 11:30am CST***<br>***11:45am – 12:30pm EST*** | **KEYNOTE: Sleep and the Pandemic -** *Meir Kryger, MD, FRCPC*<br>**Moderator:** *Christine Won, MD, MSc* |
| **11:30 – 12:00** | **Virtual Lunch Break with Exhibitors** |
| **1200 – 1300**<br>***12:00 – 1:00pm CST***<br>***1:00 – 2:00pm EST*** | **Annual General Meeting and Best Abstract Awards Session** |
| → **1200 – 1230** | **Annual General Meeting -** *Satya Krishna Ramachandran, MBBS, MD* |
| → **1230 – 1300** | **Best Abstract Awards Session -** *Toby Weingarten, MD & Eric Deflandre, MD, PhD, FCCP, FAHA* |
| **1300 – 1330** | **Break with Exhibitors** |
| **1330 – 1445**<br>***1:30 – 2:45pm CST***<br>***2:30 – 3:45pm EST*** | **Session Three: Guidelines Updates**<br>**Moderator:** *Satya Krishna Ramachandran, MBBS, MD* |
| → **1330 – 1400** | **SASM-SAMBA-SOCCA Collaborative Guidelines on Postoperative Management of Patients with OSA -** *Mandeep Singh MD, Jaime Hyman MD & Ashish Khanna MD* |
| → **1400 – 1430** | **Obstetric Guidelines -** *Jennifer Dominguez, MD, MHS* |
| → **1430 – 1445** | **Questions and Answers** |
| **1445** | **Meeting Day 2 Adjournment** |

# ABSTRACT AWARD WINNERS

FIRST PLACE AWARD

**Abstract: Prevention of Delirium in Elderly with Obstructive Sleep Apnea (PODESA): A Randomized Controlled Trial**

**Presenting Author:** Jean Wong, MD, FRCPC, Department of Anesthesiology and Pain Medicine, Toronto Western Hospital, University Health Network, Women's College Hospital, University of Toronto, Toronto, Ontario, Canada

**Co-Authors:** Mandeep Singh, MD, FRCPC, Department of Anesthesiology and Pain Medicine, Toronto Western Hospital, University Health Network, Women's College Hospital, University of Toronto, Toronto, Ontario, Canada; Stephen Choi, MD, FRCPC, Department of Anesthesia, Sunnybrook Health Sciences Centre, University of Toronto, Toronto, Ontario, Canada; Naveed Siddiqui, MD, FRCPC, Department of Anesthesia, Mount Sinai Hospital, University of Toronto, Toronto, Ontario, Canada; Frances Chung, FRCPC, Department of Anesthesiology and Pain Medicine, Toronto Western Hospital, University Health Network, University of Toronto, Toronto, Ontario, Canada

SECOND PLACE AWARD

**Abstract: Investigating the Effects of Short-Term Spinal Cord Stimulation on Sleep Health in Patients with Refractory Neuropathic Pain: A State-of-the-Art Actigraphy Analysis**

**Presenting Author:** Hannah J. Coyle-Asbil, MSc, Department of Anesthesiology and Pain medicine, Women's College Hospital, Toronto, Canada, Department of Anesthesiology and Pain medicine, Women's College Hospital, Toronto, Canada

**Supervising Author:** Mandeep Singh, MD, FRCPC, Department of Anesthesiology and Pain medicine, Women's College Hospital, Toronto, Canada, Department of Anesthesiology and Pain medicine, Women's College Hospital, Toronto, Canada

**Co-Authors:** Andrew Lim, Department of Neurology, Sunnybrook Health Sciences Center, University of Toronto, Toronto, Canada; Jamal Kara, Department of Anesthesiology and Pain medicine, Women's College Hospital, Toronto, Canada; Anuj Bhatia, Department of Anesthesiology and Pain medicine, Women's College Hospital, Toronto, Canada, Department of Anesthesiology and Pain medicine, Women's College Hospital, Toronto, Canada

THIRD PLACE AWARD

**Abstract: Using Oxygen Desaturation Index to Predict Respiratory Depression in Post-Surgical Patients Receiving Opioids. A Post Hoc Analysis from The Prediction of Opioid-induced Respiratory Depression in Patients Monitored by capnoGrapY (PRODIGY) Study**

**Presenting Author:** Lawrence SC Law, MD, National University Hospital, Singapore

**Co-Authors:** Lydia QN Liew, MBBS, MMed, National University Hospital, Singapore; Edwin Seet, MBBS, MMed, FAMS Khoo Teck Puat Hospital, Singapore; Ming Ann Sim, MBBS, National University Hospital, Singapore; Vanessa TY Chua, National University Hospital, Singapore; Ashish Khanna, MD, FCCP, FCCM, Wake Forest School of Medicine, Winston-Salem, North Carolina, US & Outcomes Research Consortium, Cleveland, OH, US; Toby Weingarten, MD, Departments of Anesthesiology and Perioperative Medicine, Mayo Clinic College of Medicine and Science, Rochester, Minnesota, US; Katherine Liu, PhD, Patient Monitoring Clinical Research, Medtronic, Minneapolis, MN, US; Fabio Di Piazza, Medtronic Core Clinical Solutions, Global Clinical Data Solutions, Rome, Italy; Lian Kah Ti, MBBS, MMed, FAMS, National University Hospital, Singapore

# THANK YOU TO OUR EXHIBITORS!

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# ABSTRACT TABLE OF CONTENTS

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**Background:** Comparing intraindividual EEG-patterns in Sleep and general anaesthesia might help to better understand beneficial EEG-signals (avoidance of burst-suppression, increased density or sleep-spindles etc) as sleep EEG-patterns may reflect sleeps' supportive physiological mechanisms maintaining cognitive homeostasis.[1 2 3]

**General aim:** To discern shared EEG-patterns in multimodal, opioid-reduced anaesthesia and postoperative nocturnal sleep in non-delirious patients.

**Materials and methods**: 25 anaesthesia (male & female, age range 23y-86y) and sleep EEGs monitored in adult elective surgery patients undergoing eye or plastic surgery in multimodal[4], opioid-reduced GA 5- electrode EEGs (MonitorTechnik, Bad Bramstedt, Germany); referenced to A2 , electrodes at Fp1/ Fps (frontal) as well as T5 /O2 (occipital) according to 10:20-system. EEG signals recorded at 128 Hz and plotted as spectrograms and multitaper spectrograms using custom scripts written in Matlab and Chronux. Scatter plots of the spindles during GA and sleep used automated spindle detection code for Matlab, a wavelet based approach .

EEGs were transformed to multitaper spectrograms helping in sleep scoring. Time spans during nocturnal sleep-stages (NREM2,3 and REM) were outlined to be compared to GA-stages characterized by EEG-signatures described as "spindle-dominant slow wave GA", "delta-dominant slow wave GA", "burst-suppression" or "beta-enhanced slow-wave GA" [5]. For these time-windows in sleep and GA spectra were computed and compared side-by-side. An automated spindle detection code was applied to both sleep and GA. Raw-EEG scoring of both intrapersonal sleep and GA was undertaken (Fig. 1,3) , paying special attention to the morphology of typical NREM2-graphoelements (spindles, K-komplexes) in sleep and GA. Occipitofrontal RPAB-values [6] were compared between the outlined GA-phases and sleep-stages like N1,N2, N3 and REM (Fig. 2). Patients were clinically screened for delirium and interviewed about satisfaction with GA.

**Results:** Comparison of spindle-frequency, delta-power (slow, fast), DSA-spectrograms and spectrograms revealed considerable overlap of early night N2 and N3-stages with GA induced by propofol and dexmedetomidine. N2 sleep (spindles 13-14 Hz) from later in the night compared better to propofol maintenance around 20 minutes after a ketamine bolus of 0.5-0.75 mg/kg/kilo. Sleep spindles were of shorter duration and smaller amplitude than GA-spindles but appeared along the same frequency bands. Burst-suppression and beta-enhanced spindle GA were EEG stages not to be found in natural sleep. Occipitofrontal RPAB was not expressed in clearcut fashion in nocturnal sleep [7]. Postoperative sleep was fragmented, especially in older patients and sleep latency much longer than normal in postoperative sleep. The 25 patients did not suffer from postoperative delirium, nausea or vomiting and reported a high degree of satisfaction.

GA-EEGs depicted comparable frequency-bands in NREM-spindle dominant GA and REM-beta-enhanced GA while demonstrating more power in all frequency-bands during GA.

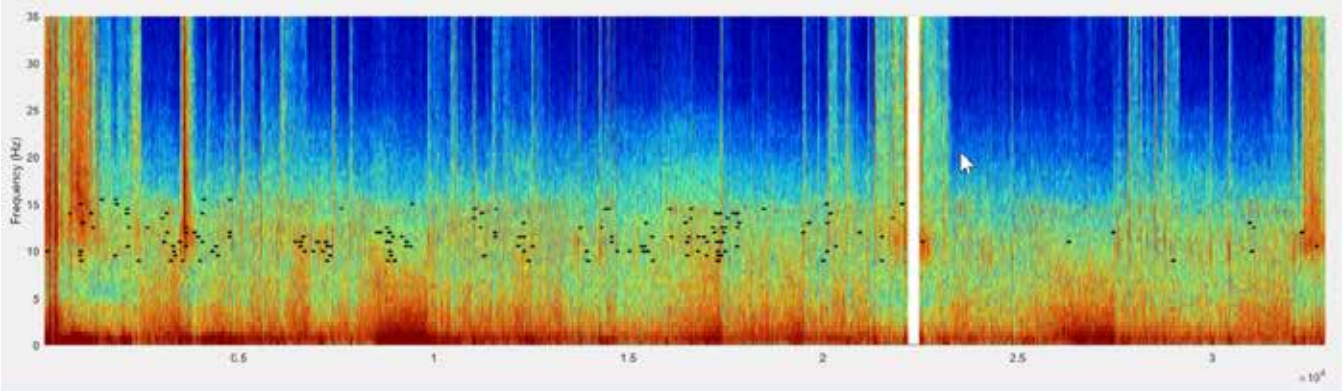


**Figure 1**: Multitaper frontal EEG of healthy 34 year old male patient, postoperative night: depicting wakefulness, Non-Rem sleep and short bouts of REM-sleep as well as many short arousals; black-dots represents spindle occurrence in respective frequency band

**Conclusion:** This observational study suffers many methodological drawback but highlights comparable brain-states in natural sleep and GA. This first-time comparison of intrapersonal sleep and GA –EEGs by means of scoring and automated spindle-recognition may outline a sphere for scientific efforts of undertaking "sleep-imitating anaesthesia" in patients at risk for delirium [8]. In the future, automated detection of "time-frequency sigma" EEG-motives might advance anaesthesia-dosing guided by the goal to maintain patients in GA- "spindling" stages of anaesthesia[9]. As for the detection of awareness-with recall, further research on occipital EEG-channels in every-day anaesthesia is needed [10].

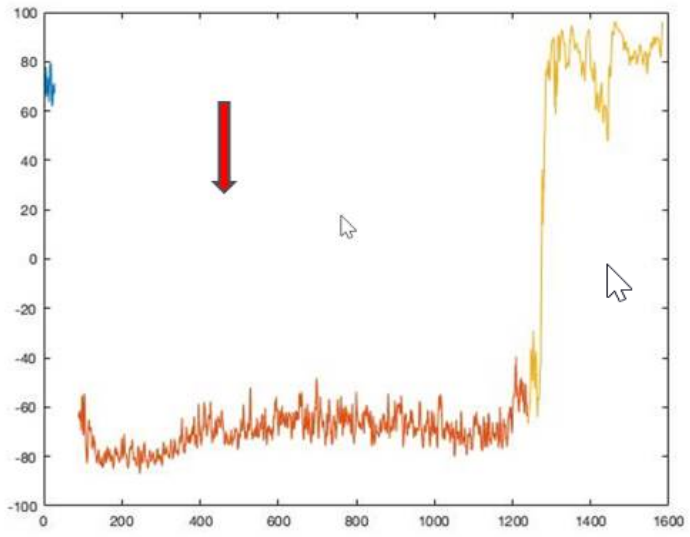


**Figure 2:** Reduced power of alpha-beta in a fronto-occipital 5-electrode, 2-channel EEG montage referenced to right mastoid of a 42 year old man undergoing vitreoretinal surgery in opiod-sparing, combined multimodal anaesthesia (GA+sub-Tenon's block) with ketamine bolus 0.75 mg/kg given at red arrow. Blue curve= awake, ocre curve=surgical GA including ketamine phase with narcotrend index rising from 34 to 81, yellow curve= emergence and postoperative wakefulness

**Background:** Current practice for monitoring the hypnotic component of anaesthesia relies, other than patient's clinical response to noxious stimuli, on processed EEG devices. During GA, various specific EEG changes have been observed, such as a shift of the alpha band (7.7-12.5 Hz) from the occipital to the frontal area, defined as anteriorization. Opposite to polysomnography including occipital electrodes, use of only frontal electrodes in neuromonitoring during general anaesthesia provides an oversimplified vision of the cerebral network interactions. A priori we proposed that a comparison of frontal and posterior alpha and beta activity could improve the quality of neuromonitoring during general anaesthesia.

**Methods**: Intraoperative EEG data recorded with the Narcotrend monitor using frontal and occipital leads referenced to the mastoid during GA in the ophthalmic surgery department of the University hospital Bern were retrospectively analysed. The Reduced Power Alpha Beta (RPAB) value, designed to usually evaluate EEG-differences between hemispheres was applied to this frontooccipital montage. The RPAB was analysed for different periods of the (wake, maintenance, emergence) as well as before and after the administration of a ketamine bolus. RPAB was additionally compared with the Spectral Edge Frequency 95 of the frontal and occipital channels.

**Results:** A significant shift of the RPAB to the occipital regions was observed in all the 32 patients after induction of GA. The combined alpha and beta power stayed reduced in the occipital channel during GA and was again reduced in the frontal channel after emergence. The administration of ketamine, used as coanalgesic during GA did not lead to a change of RPAB, although Narcotrend Index and SEF 95 reacted by significant rise during a 10 minute period after the ketamine administration.

**Conclusions:** The concept of incorporating occipital electrodes for monitoring the hypnotic state –as previously tested in polysomnography-seems promising as it adds a simplified reflection of alpha-anteriorization as an underlying physiological processs. RPAB as processed index seems to indicate reliable GA in patients with healthy frontal alpha activity unperturbed by SEF 95 or DoA index changes after ketamine bolus. To establish RPAB as reliable index reflecting physiological frontooccipital activity-differences during GA beckons further research.

**Respiratory depressive episodes in proximity to reportable adverse respiratory events during PRODIGY trial.**

Jennifer J Kor, BS, MS[1], Juraj Sprung, MD, PhD[2], Toby N Weingarten, MD[2]

**Author Affiliations:** [1]Kentucky College of Osteopathic Medicine; [2]Departments of: Anesthesiology and Perioperative Medicine, Mayo Clinic College of Medicine and Science, Rochester, Minnesota, USA

**Conflict of interest and financial disclosure:** Dr. Weingarten has received consulting fees from Medtronic and Merck.

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**Keywords:**

Respiratory depression, Opioid analgesia, Capnography

## Abstract

**Purpose –** The PRediction of Opioid-induced respiratory Depression In patients monitored by capnoGraphY (PRODIGY) trial was a multicenter prospective trial conducted to develop a risk prediction score for respiratory depressive episodes. Several subjects developed pulmonary complications which qualified as reportable adverse events. In this study we determine if those patients also had respiratory depressive episodes.

**Methods-** Blinded capnography and pulse oximetry data from patients enrolled in PRODIGY who had reportable pulmonary adverse events were reviewed. The occurrence and timing of respiratory depressive episodes (apnea, bradypnea, hypoxemia) were recorded.

**Results-** Seven United States PRODIGY patients had eight reportable pulmonary adverse events (Table). There were 187 episodes (150 apnea episodes, 14 bradypnea episodes, 23 hypoxic episodes) with median 12 [5, 19.5] episodes per patient (Figure). Five patients were monitored

prior to the adverse event, and multiple preceding respiratory depressive episodes were detected. Patient 6 had two adverse events, the first (hypoxemia) was recognized upon monitor application. This patient subsequently had multiple respiratory depressive episodes until the second adverse event occurred (somnolence requiring naloxone administration). Patient 7 adverse event (hypotension and bradypnea) was also recognized upon monitor application and also had multiple subsequent respiratory depressive episodes.

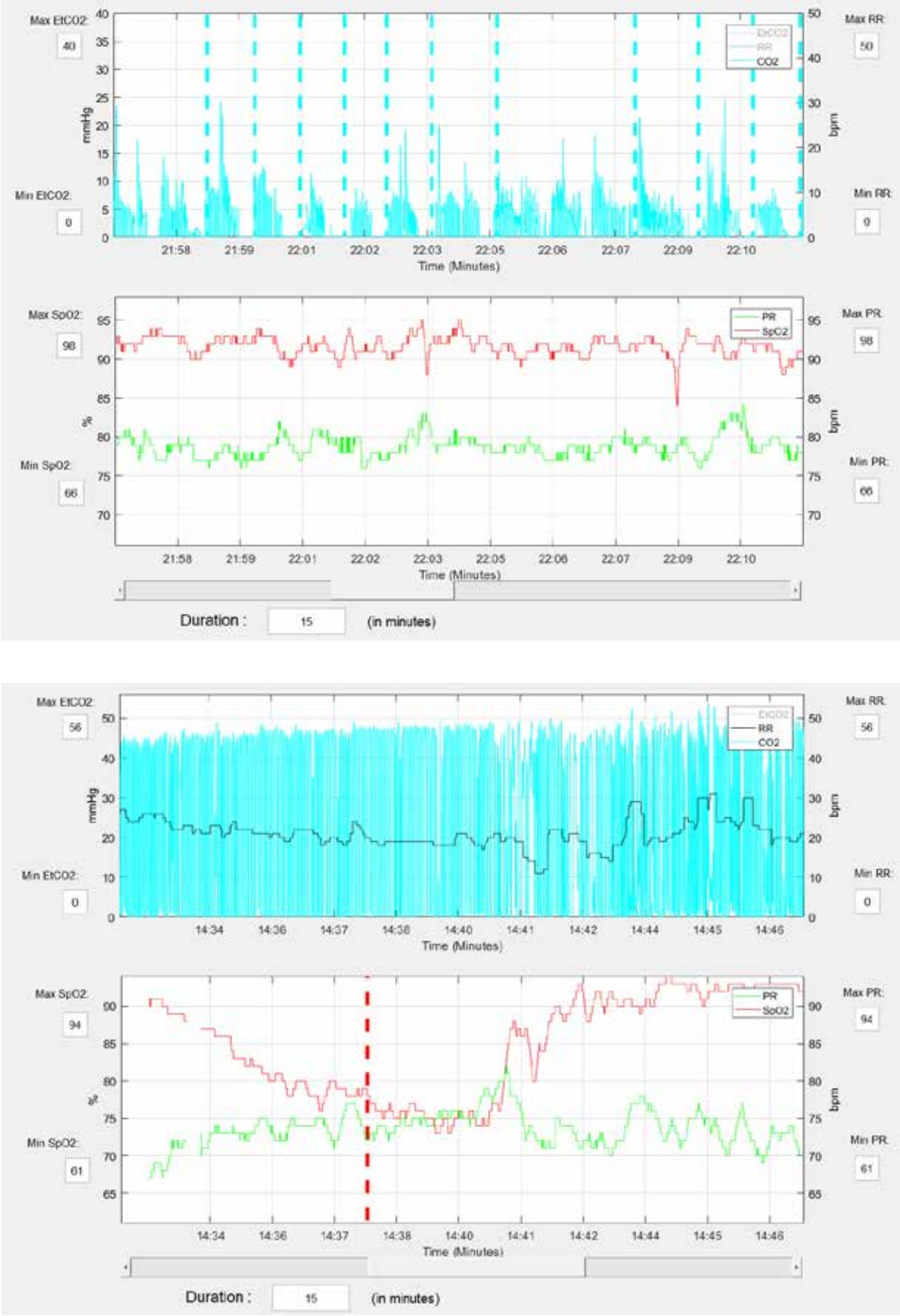
**Conclusion-** In the PRODIGY trial, patients who had a reportable pulmonary adverse event had multiple respiratory depressive episodes detected by continuous monitoring. When monitoring was initiated prior to the adverse event, numerous respiratory episodes preceded the event. These observations suggest that patients with multiple episodes of respiratory depression detected by continuous monitoring are high risk for subsequent development of serious pulmonary complications.

Table. Summary of adverse events from pulmonary causes and opioid-induced respiratory depressive episodes detected by blinded continuous respiratory monitoring.

| Patient #, age, yrs sex | PRODIGY score | Surgery | Adverse event | Monitoring duration, hrs | Monitoring initiated | ORID episodes |
|---|---|---|---|---|---|---|
| 1. 46, F | Low | General | Bradypnea | 22.4 | Prior to event | T = 16<br>A =16<br>H =0<br>D =0 |
| 2. 81, M | High | Orthopedic | Hypoxemia | 30.5 | Prior to event | T = 121<br>A =103<br>H =11<br>D =7 |
| 3. 63, F | High | Gynecology | Hypoxemia | 24.2 | Prior to event | T = 5<br>A =5<br>H =0<br>D =0 |
| 4. 68, M | High | General | Hypoxemia | 24.0 | Prior to event | T = 5<br>A =4<br>H =1<br>D =0 |
| 5. 60, F | High | General | Hypoxemia | 24.6 | Prior to event | T = 12<br>A =11<br>H =0<br>D =1 |
| 6. 75, F | High | Medical | 1. Hypoxemia<br>2. Somnolence | 26.9 | 1. During event<br>2. Prior to event | T = 23<br>A =8<br>H =0<br>D =15 |
| 7. 64, F | Intermediate | Orthopedic | Hypotension and bradypnea | 19.3 | During event | T = 5<br>A =3<br>H =2<br>D =0 |

Abbreviations: PRODIGY = PRediction of Opioid-induced respiratory Depression In patients monitored by capnography, OIRD = opioid-induced respiratory depressive episode, T=total, A=apnea (episode lasting >30 seconds), H=hypopnea (respiratory rate ≤5 breaths/min for 3 minutes), D=oxyhemoglobin desaturation (oxygen saturation ≤85% for 3 minutes).

**Figure**. Observed respiratory depressive events from continuous capnography and pulse oximetry. The top panel is from Patient 2 depicting repeated apneic episodes at the time of the adverse event. The bottom panel is from Patient 5 depicting hypoxemia at the time of the adverse event.



# Temporal Patterns of Opioid-Induced Respiratory Depression in Trauma Patients on the General Care Floor Receiving Opioids Monitored by Capnography and Pulse Oximetry: A Prospective, Blinded Observational Study

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**Acknowledgment:** Medtronic for supplying 2 Capnostream35 bedside capnography monitors, accessories, and disposables

**Conflict of interest and financial disclosure:** Dr. Weingarten has received consulting fees from Medtronic and Merck. These are not related to current study. Susan J Dempsey has received consulting fees from Medtronic. These are not related to the current study.

**Keywords:**

Respiratory depression, Trauma, Opioid analgesia, Capnography

**Validation of the STOP Questionnaire as a screening tool for the screening of obstructive sleep apnea among different populations: a systematic review and meta-analysis**

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**Background:** Obstructive sleep apnea (OSA) is a highly prevalent sleep breathing disorder that is associated with many adverse health outcomes; however, it remains largely underdiagnosed and undertreated in clinical settings. The STOP questionnaire is a simple tool to screen OSA and has been widely used across various populations.[1,2]

**General aim:** To determine the validity of the STOP questionnaire as a screening tool for OSA among different populations.

**Methods:** The following databases were systematically searched from January 2008 to April 2021: MEDLINE, MEDLINE In-process, EmCare Nursing, Embase, Cochrane Central Register of Controlled Trials, Cochrane Database of Systematic Reviews, PsycINFO, Journals@Ovid, Web of Science, Scopus and CINAHL. The inclusion criteria were: (1) STOP questionnaire was evaluated in adults, aged 18 and greater, in the sleep clinic, general, and surgical populations, commercial drivers, medical patients with co-morbidities, and different ethnic groups; (2) STOP questionnaire were validated against laboratory polysomnography (PSG) or home sleep apnea testing (HSAT); and (3) Apnea-Hypopnea Index (AHI) or Respiratory Disturbance Index (RDI) were used to diagnose OSA and grade its severity. Internal and external validity was assessed using the Cochrane Method group's guidelines for screening and diagnostic tests. The pooled predictive parameters were recalculated using 2 x 2 contingency tables and random-effects meta-analyses were performed using Review Manager 5.4 and MetaDisc 1.4.

**Results:** Of 5,726 citations, 25 studies met the inclusion criteria for the systematic review (n =14,968; mean age = 54±15; mean BMI = 30±7, 64% male). Studies were grouped and analyzed according to the type of population: 17 studies in the sleep clinic population (n =8,832), 2 studies in surgical population (n =258), 4 studies in medical patients with comorbidities (n =1,023), and one study each on commercial drivers (n =85) and general population (n =4,770). In the sleep clinic population, the prevalence of OSA (AHI ≥5), moderate-to-severe OSA (AHI ≥15), and severe OSA (AHI ≥30) was 80%, 60%, and 44%, respectively. A STOP score of ≥2 showed excellent sensitivity at the different OSA severities (>89%) and consistent diagnostic accuracy (>0.74 area under the ROC curve). The prevalence of all OSA, moderate-to-severe OSA, and severe OSA in the medical population was 73%, 41%, and 20%, respectively. In this population, the STOP questionnaire showed a high sensitivity of 85.6% at severe OSA but a consistently low diagnostic accuracy across the different OSA severities (<0.53 area under the ROC curve). Nonetheless, in both sleep clinic and medical populations, the STOP questionnaire had excellent discriminative power to exclude severe OSA with negative predictive values (NPV) >84%. The prevalence of moderate-to-severe OSA in the surgical population was 41% and the associated pooled sensitivity and NPV was 81% and 75%, respectively.

**Discussion:** Predictive parameters vary between different populations. However, the STOP questionnaire consistently demonstrated high sensitivity and NPV in the sleep clinic and in

medical patients, illustrating the effectiveness of the questionnaire in excluding clinically significant OSA in these populations.

**Conclusions** This meta-analysis demonstrates that the STOP questionnaire is a valid and effective screening tool for OSA among different populations.

**References**


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2. Chiu HY et al. Sleep Med Rev 2017; 36:57-70


**Table 1. Pooled predictive parameters of STOP 2 as the cutoff.**

| Predictive parameters (95% CI) | All OSA (AHI ≥5) | Moderate-to-severe OSA (AHI ≥15) | Severe OSA (AHI ≥30) |
|---|---|---|---|
| **Sleep clinic Population** | **(13 studies; n = 5,536)** | **(14 studies; n = 5,807)** | **(11 studies; n = 4,400)** |
| Prevalence | 80.1 (79.0-81.2) | 60.4 (59.1-61.7) | 44.9 (43.4-46.3) |
| Sensitivity | 89.5 (88.6-90.4) | 90.5 (89.4-91.4) | 94.6 (93.5-95.6) |
| Specificity | 32.9 (30.1-35.8) | 30.9 (29.1-32.9) | 24.4 (22.7-26.2) |
| Positive predictive value | 84.3 (83.3- 85.3) | 66.7 (65.3- 68.0) | 50.5 (48.8- 52.1) |
| Negative predictive value | 43.8 (40.4- 47.2) | 68.0 (65.0- 70.8) | 84.8 (81.9- 87.4) |
| Diagnostic odds ratio | 4.42 (3.17-6.15) | 5.03 (3.57-7.11) | 5.76 (3.84-8.64) |
| SROC | 0.74 | 0.77 | 0.74 |
| **Surgical Population** | **(1 study, n = 177)** | **(3 studies, n = 258)** | **(1 study, n = 177)** |
| Prevalence | - | 41.9 (35.8-48.1) | - |
| Sensitivity | - | 81.5 (72.9-88.3) | - |
| Specificity | - | 40.7 (32.7-49.0) | - |
| Positive predictive value | - | 49.7 (42.5-57.3) | - |
| Negative predictive value | - | 75.3 (64.3-83.9) | - |
| Diagnostic odds ratio | - | 2.94 (1.60-5.42) | - |
| SROC | - | 0.71 | - |
| **Medical Population** | **(2 studies, n =515)** | **(3 studies, n = 665)** | **(2 studies, n = 515)** |
| Prevalence | 73.4 (69.3-77.1) | 41.1 (37.3-44.9) | 20.2 (16.9-24.0) |
| Sensitivity | 69.6 (64.7-74.2) | 76.6 (71.1-81.5) | 85.6 (77.3-91.7) |
| Specificity | 51.8 (43.1-60.4) | 44.9 (39.9-50.0) | 41.1 (36.3-46.0) |
| Positive predictive value | 79.9 (75.1- 84.0) | 49.2 (44.3- 54.0) | 26.9 (22.2- 32.0) |
| Negative predictive value | 38.2 (31.2- 45.6) | 73.3 (67.2- 78.7) | 91.8 (86.7- 95.2) |
| Diagnostic odds ratio | 2.77 (0.95-8.10) | 2.48 (1.46-4.23) | 3.35 (1.84-6.08) |
| SROC | 0.50 | 0.53 | 0.50 |

SROC: summary of receiver operating characteristic curve

# Incidence of Opioid-Induced Respiratory Depression in Trauma Patients on the General Care Floor Receiving Opioids Monitored by Capnography and Pulse Oximetry: A Prospective, Blinded Observational Study

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**Acknowledgment:** Medtronic for supplying 2 Capnostream35 bedside capnography monitors, accessories, and disposables

**Conflict of interest and financial disclosure:** Dr. Weingarten has received consulting fees from Medtronic and Merck. These are not related to current study. Susan J Dempsey has received consulting fees from Medtronic. These are not related to the current study.

**Keywords:**

Respiratory depression, Trauma, Opioid analgesia, Capnography

**Abstract**

**Purpose** – Opioid induced respiratory depression (OIRD) among trauma patients hospitalized on general care wards has not been previously described. In this preliminary analysis we report the incidence and characteristics of OIRD as measured by bedside capnography and pulse oximetry in a cohort of trauma patients hospitalized on general care wards.

**Methods** – From July through October 2019 patients who presented to the Emergency Department following trauma and were hospitalized on general care wards were continuously monitored with bedside capnography and pulse oximetry for signs of respiratory depression (apnea, hypoxemia, hypopnea, or low expired end-breath levels of carbon dioxide). The Principal Investigator (PI, SJD) also assessed every patient within 5 minutes prior to opioid administration and every 10 minutes for 60 minutes thereafter. The adjusted Wald method was used to calculate the incidence. STOP-BANG and PRODIGY risk scores were calculated. Patients who required surgery were monitored only preoperatively.

**Results** – Nineteen patients were admitted for a traumatic injury to a general care ward and underwent continuous monitoring with capnography and pulse oximetry. Indications for admission were orthopedic (n=15), chest (n=3), and abdominal (n=1) trauma; and all patients were administered opioids in the emergency and general care wards and 12 required surgical management. High risk STOP-BANG and PRODIGY scores were calculated for 5 (26.3%) and 8 (42.1%) patients, respectively. The median duration of monitoring was 7.0 [6.4, 7.4] hours. Respiratory depression was detected in 14 patients (incidence 71 [95%CI 50.9 – 88.6] cases per 100 patients) with apnea (n=12) and hypoxemia (n=10) the most detected abnormalities and hypopnea (n=5) and low expired end-breath carbon dioxide level (n=4) less common. Respiratory depression was observed in 6 patients prior to administration of opioids on the ward

and observed in 13 patients following opioid administration on the ward. The PI observed these episodes of respiratory depression in 7 (54%) patients following opioid administration. Preoperative characteristics and medications administered in the emergency room and hospital room are summarized in the Table. No patient experienced a life-threatening adverse respiratory event or required naloxone.

Conclusion – Respiratory depression detected by bedside capnography and pulse oximetry was common among trauma patients hospitalized on general care wards. Direct observation of patients for an hour following opioid administration failed to observe over 50% respiratory events, offers compelling evidence that there is an un-met need for continuous monitoring in this patient population.

| | Total N = 19 | Respiratory depression N = 14 | No respiratory depression N = 5 | P |
|---|---|---|---|---|
| **Baseline characteristics** | | | | |
| Age, , | 40 [32, 60.5] | 37.5 [31.5, 61] | 42 [40, 59] | 0.733 |
| Body mass index, kg/m$^2$ | 29.9 [24.4, 32.6] | 30.6 [27.0, 33.4] | 23.5 [23.4, 32.5] | 0.266 |
| Male sex | 12 (63.2) | 8 (57.1) | 4 (80.0) | 0.603 |
| White race | 16 (84.2) | 12 (85.7) | 4 (80.0) | >0.999 |
| STOP BANG | | | | 0.248 |
| Low risk | 7 (36.8) | 4 (28.6) | 3 (60.0) | |
| Intermediate risk | 7 (36.8) | 5 (35.7) | 2 (40.0) | |
| High risk | 5 (26.3) | 5 (35.7) | 0 | |
| PRODIGY Category | | | | 0.678 |
| Low risk | 5 (26.3) | 3 (21.4) | 2 (40.0) | |
| Intermediate risk | 6 (31.6) | 5 (35.7) | 1 (20.0) | |
| High risk | 8 (42.1) | 6 (42.9) | 2 (40.0) | |
| **Emergency room course** | | | | |
| Duration, hrs | 10 [7, 13.5] | 9.9 [7.8, 13.2] | 11.5 [4.0, 23.0] | >0.999 |
| Opioids, mg IVME | 10.5 [4.6, 14.0] | 9.3 [5.0, 17.4] | 12.6 [1.0, 13.2] | 0.578 |
| Intravenous sedation | 5 (26.3) | 4 (28.6) | 1 (20.0) | >0.999 |
| Oral sedation | 4 (21.1) | 3 (21.4) | 1 (20.0) | >0.999 |
| **General care ward course** | | | | |
| Opioids, mg IVME | 5.7 [4.0, 6.3] | 7.7 [6.8, 8.0] | 5.3 [3.8, 6.8] | 0.266 |
| Gabapentin | 3 (15.8) | 3 (21.4%) | 0 | 0.530 |
| Supplemental oxygen | 4 (21.1) | 4 (28.6) | 0 | 0.530 |

**Abstract Title: Racial disparity and the postoperative consequences of pediatric preoperative OSA diagnosis in a non-ENT cohort.**

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**Introduction**: Obstructive sleep apnea (OSA) is a highly prevalent sleep disorder that disproportionately affects African American children. Relatedly, African American families are less likely to utilize sleep services such as overnight polysomnography, which is the gold-standard for OSA diagnosis. Thus, OSA among African-American children often goes undiagnosed and untreated, which has significant health consequences, including increased postoperative complications (1). Many reports of the perioperative complications of OSA are confounded by the inclusion of children undergoing pharyngeal or airway operations in the sample (2). These Ear, Nose, and Throat (ENT) procedures have higher risks of pulmonary complications (3). Whether racial disparities exists in the perioperative consequences of OSA diagnosis in a non-ENT surgical cohort is unknown. Therefore, the objective of this study was to quantify the contribution of comorbid OSA diagnosis to racial disparities in postoperative complications of children undergoing elective non-ENT surgical procedures. The hypothesis tested was that there is no significant difference by race in the frequency of postoperative complications among a cohort of African American and White children with comorbid OSA undergoing inpatient non-ENT surgery.

**Methods**: This was a multicenter, propensity score-matched, retrospective study of the Pediatric Health Information System (PHIS) database. Subjects were adolescents (2-17 years) with a preoperative diagnosis of OSA undergoing inpatient surgery between 2004 and 2019. Race (African American vs. White) was the main exposure. Primary outcome was serious perioperative pulmonary complications (laryngospasm, bronchospasm and respiratory failure). Secondary outcomes were pneumonia, ICU admission, mechanical ventilation, prolonged hospital stay, and in-hospital mortality.

**Results:** After 1:1 matching, there were 3622 patients. The adjusted risk of major pulmonary complications was higher in African American children with comorbid OSA than in their White peers (24.4% vs 18.2%, adjusted-OR [aOR]: 1.43; 95% CI: 1.22-1.70; $p<0.01$, Table 1). African American children were also more likely to suffer postoperative pneumonia, require mechanical ventilation, ICU admission, and to have extended post-surgical hospital stay. The adjusted risk of mortality was slightly higher in African American children although the difference was not statistically significant ($p=0.86$, Table 1).

**Conclusion:** Following inpatient non-ENT surgery, African American children with comorbid OSA were more likely than their White peers to suffer major pulmonary complications, require mechanical ventilation, ICU admission, and an extended post-surgical stay. Mechanisms underlying disparity in morbidity and increase cost of surgical care in children with OSA deserve further elucidation.

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**Table 1.** Multivariable analysis of factors associated with comorbid OSA by race.

| Outcome | White Children No. of event(%)‡ | Black Children No. of event(%)‡ | Odds ratio(95%CI)† | P-values |
|---|---|---|---|---|
| Mortality | 15(0.8) | 16(0.9) | 1.07(0.53,2.16) | 0.86 |
| ICU admission | 895(49.4) | 976(53.9) | 1.21(1.06,1.39) | 0.01 |
| Laryngospasm/Bronchospasm/Respiratory failure | 331(18.3) | 438(24.2) | 1.44(1.22,1.70) | <0.01 |
| Pneumonia | 108(6.0) | 139(7.7) | 1.31(1.01,1.71) | 0.04 |
| Mechanical ventilation | 462(25.5) | 540(29.8) | 1.26(1.08,1.47) | <0.01 |
| Extended hospital stay | 714(39.4) | 843(46.6) | 1.37(1.19,1.57) | <0.01 |


**Figure 2. Propensity score-adjusted analyses of major pulmonary complications, comparing Black to White children with comorbid OSA and admitted for non-ENT surgery PHIS 2015-2019.**

‡Percentages are for row.

†Estimated using propensity score-adjusted conditional logistic regression models.

**Abbreviation:** 95%CI, 95% confidence interval; PHIS, Pediatric health information system.ICU, intensive care unit.

The SANDMAN Study: Sleep Apnea, Neuroinflammation, and Cognitive Dysfunction Manifesting After Non-cardiac surgery

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**Background:** Up to 40% of older patients will develop a postoperative neurocognitive disorder, such as delirium and postoperative neurocognitive disorder. Postoperative neurocognitive disorder includes subjective cognitive complaints and objective thinking/memory deficits that occur 1-12 months after surgery;[1] these objective cognitive deficits alone have been referred to as postoperative cognitive dysfunction (POCD). POCD has been associated with decreased quality of life,[2] increased mortality,[3] and further long-term cognitive decline.[4] One possible POCD risk factor is obstructive sleep apnea (OSA), a frequently undiagnosed disorder characterized by breathing interruptions (apneas and hypopneas) during sleep. OSA is highly prevalent in older surgical patients and can be diagnosed with home sleep apnea tests (HSAT), which measure the apnea-hypopnea index (AHI, apneas and hypopneas/hour) to diagnose OSA and measure its severity. Although OSA has been associated with long-term cognitive decline,[5] earlier dementia onset,[6] and postoperative delirium,[7] the role of OSA in POCD is unknown. POCD might be increased in OSA patients due to neuroinflammation, since OSA patients have increased peripheral inflammation[8] and increased magnetic resonance spectroscopy (MRS) markers of neural damage,[9] few studies have determined whether older OSA patients actually have increased neuroinflammation. Thus, In SANDMAN, we will determine the extent to which OSA is associated with POCD severity and cerebrospinal fluid (CSF) inflammatory markers, and also obtain whole-brain MRS feasibility data.

**General Aim**: This prospective clinical-translational study aims to determine the extent that untreated OSA in older surgical patients is associated with increased POCD severity and neuroinflammation.

**Methods**: SANDMAN is a sub-study of the IRB-approved INTUIT study, in which 200 patients age>60 undergoing major non-cardiac/non-neurologic surgery undergo blood and CSF sampling and cognitive testing before, 24 hours and 6 weeks after surgery. Nineteen CSF inflammatory markers are measured with multiplex ELISA assays. In SANDMAN, 100 INTUIT patients will also complete preoperative HSAT to diagnose OSA and quantify its severity. Ten SANDMAN patients will also undergo pre- and postoperative MRS to measure markers of neural (N-Acetylaspartate) and white matter (choline) damage. The association of AHI with postoperative cognition will be assessed via multivariate analysis adjusting for age, preoperative cognition, and education. The relationship between AHI and CSF cytokines will be assessed with univariate linear regression.

**Results:** As of 4/1/2021, 83 patients have enrolled in SANDMAN, with 79 patients successfully completing HSAT. The distribution of OSA severity is shown in Figure 1; 62% of patients were diagnosed with OSA. Twelve patients have completed preoperative whole-brain MRS, with ten of those patients also completing postoperative whole-brain MRS.

**Discussion**: To date, 95% of older surgical patients in SANDMAN have successfully completed HSAT. The majority of patients who have successfully completed HSAT have undiagnosed OSA. Undiagnosed OSA in older surgical patients might be a modifiable risk factor for perioperative neurocognitive disorders such as delirium and postoperative neurocognitive disorder.

**Conclusion:** SANDMAN is assessing the relationship between OSA, neuroinflammation, and POCD. We hypothesize that OSA is associated with POCD severity and increased neuroinflammation. If true, this finding could lead to potential interventions, such as preoperative detection and treatment of OSA, to prevent POCD.

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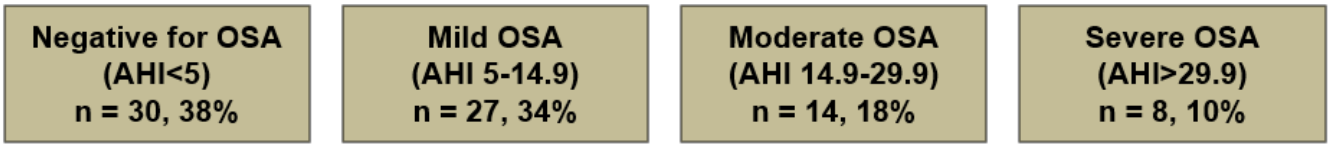
## Figure 1: Sleep Apnea Severity Distribution:



Back to Abstract Table of Contents

# Methodological Limitations of Naloxone Administration as a Proxy for Opioid-Induced Respiratory Depression

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**Word count: 310**

**Acknowledgment:** None

**Conflict of interest and financial disclosure:** None

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**Keywords**

Opioid induced respiratory depression (OIRD)

Naloxone

## ABSTRACT

**Background –** Opioid induced respiratory depression (OIRD) is a well-established cause of mortality among the patient who are prescribed opioids for both acute and chronic pain management.

**Aim –** Naloxone is an effective reversal agent for OIRD and has been used as a proxy for this complication. In this study we examined the rate of response of hospitalized patients to naloxone to reverse suspected OIRD.

**Methods –** We studied the incidence of administration and performed a retrospective review from May 2018 through October 2020 in patient who received naloxone. We stratified patients based on the response to naloxone therapy as either “Responder” or “Non-Responder” groups and compared overall clinical characteristics and outcomes among these two groups.

**Results –** The data of 192,837 patients was retrospectively reviewed (86,030 medical and 106,807 surgical on admissions). Naloxone was administered in 162 patients, and among these 124 (76.5%) were Responders while 38 (23.5%) were Non-responders. Baseline characteristics of both groups were similar (Table 1). Total median consumption of opioid dose in 24 hours prior to naloxone administration was 46 mg (IQR 22.5,87.4) in the Responder group and 39 mg (IQR 15.8,56.3) in the Non-Responder group ($p$=0.063). Both groups had similar median last dose of opioid administration 9 mg (IQR 4.5, 15) (Table 1). Physiologic parameters recorded prior to giving naloxone were similar among both groups except respiratory rate which was less than 8 bpm in 74% of Responders vs 63% of Non-Responders ($p$=<0.001) (Table 1). Majority of the Non-Responders were transferred to ICU compare to Responder group (76% vs 43%, $p$=<0.001). Higher in-

hospital mortality was noted in Non-Responder compare to Responder group (29% vs 7.3%, *p*=<0.001) (Table 1).

**Conclusion –** Patients who presented with bradypnea were more responsive to naloxone therapy. Patients who did not respond to naloxone therapy, had poor outcomes, and increased in-hospital mortality as compared to those patients who responded to naloxone therapy.

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**Table 1.** Comparison of baseline characteristics, event circumstances and outcomes of Responder and Non-responder group who received naloxone.

| Variable | Responder Group N= 124 | Non-responder Group N=38 | *p* |
|---|---|---|---|
| Section I: Baseline characteristics | | | |
| Age, years | 64.8 ± 15.7 | 67.7 ± 17.3 | 0.329 |
| Male Gender | 48 (38.7) | 14 (36.84) | >0.999 |
| Patient type | | | 0.571 |
| Medical patients | 74 (59.7) | 25 (65.8) | |
| Surgical patients | 50 (40.3) | 13 (34.2) | |
| Body mass index, kg/m$^2$ | 27.9 ± 11.4 | 28.4 ± 9.1 | 0.817 |
| Charlson comorbidity index | 2.5 [1, 4] | 3 [2, 5.3] | 0.103 |
| PRODIGY score (High risk) | 79 (63.7) | 25 (65.8) | 0.668 |
| Obstructive sleep apnea | 43 (34.7) | 13 (34.2) | >0.999 |
| Cardiovascular disease | 96 (77.4) | 36 (94.7) | 0.016 |
| Diabetes | 52 (41.9) | 19 (50.0) | 0.456 |
| Chronic kidney disease | 16 (12.9) | 8 (21.1) | 0.295 |
| Chronic pain syndrome | 25 (20.2) | 5 (13.2) | 0.474 |
| Home medications | | | |
| Opioids | 27 (28.1) | 4 (16.0) | 0.305 |
| Outpatient methadone | 4 (4.2) | 1 (4.0) | >0.999 |
| Antidepressants | 38 (30.7) | 10 (26.3) | 0.688 |
| SSRI | 13 | 5 | |
| SNRI | 21 | 4 | |
| TCAs | 5 | 2 | |
| Benzodiazepines | 22 (17.7) | 5 (13.2) | 0.624 |
| Gabapentinoids | 47 (37.9) | 15 (39.5) | 0.851 |
| Section II: Opioid and other medication administration prior to naloxone administration | | | |
| Time from admission to naloxone, hours | 52 [18, 103] | 79 [31, 181] | 0.064 |
| Total opioid dose 24-hr before naloxone, OME, mg* | 45.8 [22.5, 87.4] | 38.8 [15.8, 56.3] | 0.063 |
| Time from last dose of opioids to naloxone, hours | 4 [2, 6] | 5 [3, 7] | 0.092 |
| Last opioid dose before naloxone, OME, mg | 9 [4.5, 15] | 9 [4.5, 15] | 0.894 |
| Time from admission to naloxone, hours | 52 [18, 103] | 79 [31, 181] | 0.064 |
| Other sedative medications | | | |
| Benzodiazepines | 53 (42.7) | 15 (39.5) | 0.851 |

| | | | |
|---|---|---|---|
| Gabapentinoids | 63 (50.8) | 23 (60.5) | 0.354 |
| Zolpidem | 5 (4.0) | 1 (2.6) | >0.999 |
| Haloperidol | 8 (6.5) | 3 (7.9) | 0.721 |
| Section III: Last recorded vital signs before naloxone and description of the event | | | |
| Last vital sign before naloxone, min | 17 [6, 58] | 10 [5, 41.8] | 0.285 |
| Cardiovascular | | | |
| Heart rate | 86 [71.3, 99.8] | 90 [71, 104.5] | 0.363 |
| Mean arterial blood pressure, mmHg | 79.3 [67, 93.3] | 78.7 [62.3, 100.2] | 0.946 |
| Bradycardia (<60 beats per min) | 14 (12.1) | 4 (11.1) | >0.999 |
| Tachycardia (>100 beats per min) | 29 (25.0) | 12 (33.3) | 0.390 |
| Hypotension, SBP <90 mmHg | 18 (18.2) | 6 (18.2) | >0.999 |
| Hypertension, SBP >120 mmHg | 40 (40.4) | 15 (45.5) | 0.685 |
| Respiratory | | | |
| Respiratory rate <8 per min | 31 (33.7) | 0 (0) | <0.001 |
| Pulse oximetry saturation | 95 [90.5, 98] | 95 [91, 97] | 0.986 |
| Hypoxemia, $SatO_2$ <90% | 28 (24.8) | 7 (20.0) | 0.653 |
| Supplemental $O_2$ before the event | 65 (52.9) | 15 (39.5) | 0.194 |
| Richmond agitation–sedation scale (RASS) | -2 [-3, -1] | -2 [-4, -1] | 0.106 |
| Section IV: Interventions and outcomes | | | |
| Rapid response team | 80 (65.6) | 31 (81.6) | 0.071 |
| Transfer to intensive care unit | 52 (42.6) | 29 (76.3) | <0.001 |
| Additional intervention | | | |
| Cardiopulmonary resuscitation | 2 (5.3) | 1 (0.8) | 0.138 |
| Endotracheal intubation | 0 (0.0) | 4 (3.2) | 0.574 |
| Positive airway pressure therapy | 3 (2.4) | 3 (7.9) | 0.142 |
| Flumazenil | 4 (3.2) | 0 (0.0) | 0.574 |
| Disposition/discharge/outcome | | | <0.001 |
| Expired in hospital | 9 (7.3) | 11 (29.0) | <0.001 |
| Home | 73 (58.9) | 10 (26.3) | |
| Hospice | 9 (7.3) | 4 (10.5) | |
| Left against medical advice | 1 (0.8) | 0 (0.0) | |
| Skilled nurse facility | 32 (25.8) | 13 (34.2) | |
| 30-day mortality* | 17 (13.7) | 12 (31.6) | 0.016 |

Section I: Categorical variables are summarized using number (percent) and compared between groups using Fisher's exact test. Continuous variables are summarized using mean ± SD, or median [25%, 75% interquartile range], and compared between groups using the two-sample t-test, or Kruskal-Wallis test.

*Abbreviations*: PRODIGY = PRediction of Opioid-induced respiratory Depression In patients monitored by capnoGraphY, OME = Oral morphine equivalents

Section II: Oral Morphine Equivalents (OME) were calculated with the opioids administrated during 24 hours before naloxone administration. Thirty-six patients in the Responders group and 7 non-responder patients received naloxone within 24 hours from admission, opioids were recorded during that time.

Section III: Categorical variables are summarized using number (percent) and compared between groups using Fisher's exact test. Continuous variables are summarized using median [25%, 75% interquartile range], and compared between groups using Kruskal-Wallis test.

*Abbreviations*: SBP = systolic blood pressure; RASS, Richmond Agitation-Sedation Scale; NPRS, numeric pain rating scale.

Section IV: Data presented as number (percent), median [25%, 75% interquartile range]. *Defined as 30 days from hospital admission.

**Validation of the STOP-Bang Questionnaire as a Screening Tool for Obstructive Sleep Apnea in Surgical Patients**

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**Background:** Obstructive sleep apnea (OSA) is a common sleep-related breathing disorder that is highly associated with postoperative complications.[1] It is important to identify OSA in surgical patients for perioperative risk stratification. The gold standard for diagnosis of OSA is in-laboratory polysomnography (PSG). However, PSG is expensive and time consuming. STOP-Bang questionnaire is a simple tool to screen OSA which takes only 1-2 minutes.[2]

**General Aim:** To evaluate whether the STOP-Bang questionnaire is a valid tool in screening for obstructive sleep apnea in patients undergoing surgery.

**Methods:** The following databases were systematically searched from 2008 to May 2021: MEDLINE, Medline-in-process, Embase, Cochrane Central Register of Controlled Trials, Cochrane Database of Systematic Reviews, PsycINFO, Journals @ Ovid, Web of Science, Scopus, and CINAHL The inclusion criteria were: 1) STOP-Bang questionnaire used as an OSA screening tool in surgical patients (age >18 years); 2) validated against laboratory polysomnography or home sleep apnea testing; 3) Apnea-hypopnea Index (AHI) was used to define OSA and its severity. The internal and external validity of the included studies were appraised using criteria described by the Cochrane Methods group on screening and diagnostic tests. A random-effects model was used to obtain pooled predictive parameters like sensitivity and specificity, positive (PPV) and negative predictive value (NPV), diagnostic odds ratio, and area under the sROC curve (AUC) to assess the validity of the STOP-Bang questionnaire for different AHI cut-offs (AHI ≥ 5, AHI ≥ 15, AHI ≥ 30 events per hour). The meta-analysis was performed using Review Manager 5.4 and MetaDisc 1.4.

**Results:** The systematic search resulted in 3,141 articles, of which 9 studies (n = 2,042) were included in the final analysis. The mean age of the surgical population was 52.6 ± 15.3 years with mean BMI of 34.9 ± 10.2 kg/m$^2$, and 40.1% were male. In the surgical population, the prevalence of any OSA (AHI ≥ 5), moderate-to-severe OSA (AHI ≥ 15), and severe OSA (AHI ≥ 30) was 62.6%, 41.2%, and 19.3% respectively. The STOP-Bang questionnaire was found to have a pooled sensitivity of 83.9% (95%CI:80.8-86.7%), 75.2% (95%CI:71.5.5-78.6%), and 84.8% (95%CI:79.1-89.3%) to screen for any (AHI ≥ 5), moderate-to-severe (AHI ≥ 15), and severe (AHI ≥ 30) OSA, respectively. The pooled specificity was 47.5% (95%CI:42.5-52.7%), 22.5% (95%CI:19.8-25.5%), and 34.2% (95%CI:31.1-37.5%) for any, moderate-to-severe, and severe OSA, respectively. The AUC was 0.89, 0.62, and 0.63 for any, moderate-to-severe, and severe OSA, respectively.

**Discussion:** The high sensitivity and significant diagnostic odds ratio of a STOP-Bang score ≥ 3 helped to identify those in the surgical who are at risk for OSA. In the surgical population, the

high sensitivity of a STOP-Bang score ≥ 3 means that the questionnaire is a valid screening tool to detect any OSA in the surgical cohort.

**Conclusion:** The STOP-Bang questionnaire is a valid tool to screen for OSA in surgical patients, with a high sensitivity of 83.9% to detect any OSA with AUC of 0.89. It is effective to exclude severe OSA with NPV of 90.4%.

**Table 1. Pooled predictive parameters of STOP-Bang ≥ 3 for surgical patients.**

| Predictive parameters | Any OSA (AHI ≥5) | Moderate-to-Severe OSA (AHI ≥15_ | Severe OSA (AHI ≥30) |
|---|---|---|---|
| | (3 studies, n = 1009) | (7 studies, n = 1456) | (3 studies, n = 1091) |
| Prevalence | 61.6 (58.6 – 64.6) | 41.2 (38.7 – 43.8) | 19.3 (17.1 – 21.8) |
| Sensitivity | 83.9 (80.8 – 86.7) | 75.2 (71.5 – 78.6) | 84.8 (79.1 – 89.3) |
| Specificity | 47.5 (42.5 – 52.7) | 22.5 (19.8 – 25.5) | 34.2 (31.1 – 37.5) |
| Positive predictive value | 72.0 (68.6 – 75.2) | 40.5 (37.6 – 43.4) | 23.6 (20.7 – 26.8) |
| Negative predictive value | 64.7 (58.9 – 70.2) | 56.4 (51.0 – 61.7) | 90.4 (86.6 – 93.2) |
| Diagnostic odds ratio | 5.01 (2.61 – 9.58) | 2.13 (0.56 – 8.12) | 4.03 (1.62 – 10.01) |
| Area under the curve | 0.887 | 0.616 | 0.625 |

Data presented with 95%CI

**References:**

1. British Journal of Anesthesia. 2012;109(6):897-906
2. Chest. 2016;149: 631 – 638

**Introduction**

Obstructive sleep apnea (OSA) is a sleep-related breathing disorder arising from dysfunction of the upper airway during somnolence. OSA has significant associated morbidity and mortality and is often underdiagnosed. The STOP-Bang questionnaire is a widely used tool to screen individuals at high risk of OSA. One parameter assessed in the questionnaire is neck circumference. This study examines the diagnostic performance of the STOP-Bang questionnaire with or without neck circumference. We hypothesise that the diagnostic performance of STOP-Bang will be higher with than without the neck circumference parameter.

**Methods**

A retrospective study was conducted which included patients from preoperative clinics of two hospitals in Toronto. The inclusion criteria of the study involved patients ≥18 years undergoing surgery for elective procedure. All consented patients completed the STOP-Bang questionnaire [S: Snoring, T: Tiredness, O: Observed apnea, P: Pressure, BMI (> 35 kg/m2), age (> 50 years), neck circumference (> 40 cm), and gender (male)] and underwent overnight polysomnography at the sleep laboratory. The diagnostic parameters were calculated for STOP-Bang and STOP-Bag questionnaires.

**Results**

There were 203 patients with mean age of 56.5 ± 12.7 years and 51.2% were male. The STOP-Bang questionnaire had a significantly higher area under receiver operating curve than the STOP-Bag questionnaire. (0.782 vs. 0.758, $P<0.05$).

Similarly, McNemar test showed that the STOP-Bang questionnaire had significantly higher sensitivity when compared to the STOP-Bag questionnaire (85.5% vs 81.3%, $p<0.05$).

**Conclusion**

This study identified that the inclusion of neck circumference in the STOP-Bang assessment tool provides significantly better diagnostic value compared to when excluding the parameter. Despite the parameter often being overlooked in clinical assessment, these findings signify the importance of its inclusion in OSA assessment.

**SASM 2021 Abstract**

**Title**: Oximetry-derived nocturnal hypoxemia is associated with postoperative cardiovascular events in patients with unrecognized obstructive sleep apnea undergoing major non-cardiac surgery

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**Background:**

Obstructive sleep apnea (OSA) is known to be associated with postoperative cardiovascular events in patients undergoing major non-cardiac surgery. OSA is highly prevalent and underdiagnosed in the surgical population due to the complexity of polysomnography. Overnight oximetry can identify those at risk of sleep apnea by detecting nocturnal hypoxemia. The objective of the study is to determine whether overnight oximetry can identify those at risk of sleep apnea and its association with 30-day postoperative cardiovascular events.

**Methods:**

The study was a planned post hoc analyses of a multicenter prospective cohort study involving 1,218 at-risk surgical patients without a prior risk of sleep apnea. The inclusion criteria were patients ≥45 years old undergoing non-cardiac surgery with 1 or more risk factors for

postoperative cardiovascular events. All patients underwent pulse oximetry (PULSOX-300i, Konica Minolta Sensing, Inc) before surgery. Severity of sleep apnea were classified based on oxygen desaturation index (ODI) (<5 as no, ≥5 to <15 as mild, ≥15 to <30 as moderate, ≥30 events/hour as severe OSA). ODI is defined as the number of events per hour with at least 4% decrease in saturation from the average saturation in the preceding 120s for at least 10s. Multivariable Cox regression analysis was used to examine the association between cardiovascular events and sleep apnea severity. Cardiovascular events were a composite of myocardial injury, cardiac death, congestive heart failure, thromboembolism, atrial fibrillation, and stroke within 30 days of surgery.

**Results:**

Of 1,218 patients, the mean age was 68 ± 9 years and body mass index was 27 ± 5 kg/$m^2$. The rate of postoperative cardiovascular events was 6.3% (33/523) for patients with ODI ≥5 to <15 events/hour, 14% (34/246) for patients with ≥15 to <30 events/hour, 21.5% (26/121) for patients with ODI ≥30 events/hour. Adjusting for age, gender, ethnicity, type of surgery, and pre-existing conditions, multivariable analysis showed that ODI ≥15 to ODI <30 (adjusted hazard ratio, aHR 2.65 [95% confidence interval (CI): 1.47-4.79]} and ODI ≥30 (aHR 4.18 [95% CI: 2.25-7.80]) lowest $SpO_2$ ≤ 85 % (aHR 2.06 [95% CI: 1.12-3.78]), CT90 ≥ 20 minutes (aHR 2.50 [95% CI: 1.69-3.70]), CT80 ≥ 10 minutes (aHR 3.30 [95% CI: 2.16-5.04]) were independent predictors of 30-day postoperative cardiovascular events (Table 1).

**Conclusions:**

Moderate (ODI ≥15 to <30) and severe OSA (ODI ≥30), lowest SpO2 < 85, CT90 ≥ 20 min and CT80 ≥ 10 min are associated with increased risk of 30-day postoperative cardiovascular events in patients undergoing major non-cardiac surgery. Preoperative screening using oximetry will help in risk stratification and optimizing earlier treatment for those that are at high risk of sleep apnea and postoperative cardiovascular morbidity.

**Table 1. Association between oximetry parameters and postoperative primary outcomes**

| Variables | aHR (95 % CI)<br><br>ODI (events per hour) | aHR (95 % CI)<br><br>Lowest $SpO_2$, % | aHR (95 % CI)<br><br>CT 90 (min) | aHR (95 % CI)<br><br>CT 80 (min) |
|---|---|---|---|---|
| | < 5, reference<br>≥ 5 - <15<br>≥ 15 - <30<br>≥ 30 | >85, reference<br>≤ 85 | <20, reference<br>≥20 | <10, reference<br>≥10 |
| | 1.18 (0.66-2.12)<br>2.65 (1.47-4.79)**<br>4.18 (2.25-7.80)** | 2.06 (1.12-3.78)* | 2.50 (1.69-3.70)** | 3.30 (2.16-5.04)** |
| **Age (years)** | | | | |
| <65 years, ref | | | | |
| 65-74 years | 1.95 (1.50-3.29)* | 2.13 (1.24-3.61)** | 2.03 (1.98-3.42)** | 2.12 (1.25-3.59)** |
| ≥75 years | 3.01 (1.72-5.26)** | 3.17 (1.81-5.56)** | 3.02 (1.73-5.28)** | 3.01 (1.70-5.17)** |
| **Sex, Male** | 1.44 (0.91-2.29) | 1.62 (1.03-2.55)* | 1.56 (0.99-2.46) | 1.54 (0.97-2.45) |
| **Ethnicity** | | | | |
| Malay, ref | | | | |
| Caucasian | 1.22 (0.48-3.10) | 1.07 (0.42-2.70) | 0.92 (0.36-2.31) | 1.19 (0.47-3.02) |
| Chinese | 1.86 (0.89-3.90) | 1.67 (0.80-3.48) | 1.69 (0.81-3.51) | 1.59 (0.77-3.31) |
| Indian | 2.21 (0.91-5.39) | 1.89 (0.78-4.61) | 1.91 (0.79-4.63) | 2.10 (0.86-5.09) |
| **Hypertension** | 1.89 (0.87-4.13) | 2.22 (1.02-4.82) | 2.02 (0.93-4.39) | 2.16 (0.99-4.70) |
| **CAD** | 1.61 (1.06-2.45)* | 1.58 (1.04-2.42)* | 1.58 (1.04-2.40)* | 1.60 (1.05-2.44)* |
| **Heart failure** | 3.05 (1.65-5.65)** | 2.81 (1.54-5.14)** | 3.05 (1.66-5.59)** | 3.12 (1.70-5.73)** |
| **PVD** | 1.16 (0.64-2.11) | 1.19 (0.65-2.17) | 1.32 (0.72-2.44) | 1.28 (0.70-2.36) |
| **Stroke** | 1.32 (0.82-2.11) | 1.20 (0.75-1.92) | 1.32 (0.83-2.10) | 1.32 (0.83-2.10) |
| **COPD** | 1.21 (0.61-2.39) | 1.17 (0.58-2.36) | 1.10 (0.55-2.18) | 1.04 (0.53-2.03) |
| **Renal impairment** | 2.67 (1.53-4.67)** | 3.02 (1.74-5.23)** | 2.71 (1.57-4.70)** | 2.61 (1.50-4.54)** |
| **Beta blockers** | 0.87 (0.58-1.31) | 0.95 (0.63-1.42) | 0.95 (0.64-1.42) | 0.98 (0.65-1.46) |
| **Surgery for cancer** | 1.81 (1.07-3.08)* | 1.65 (0.97-2.81) | 1.79 (1.04-3.07)* | 1.73 (1.00-2.97)* |
| **Intraperitoneal or vascular surgery** | 1.73 (0.99-3.02) | 1.68 (0.97-2.92) | 1.75 (0.99-3.07) | 1.60 (0.91-2.80) |

The primary outcome was a composite of myocardial injury, cardiac death, congestive heart failure, thromboembolism, new atrial fibrillation, and stroke within 30 days of surgery. aHR: adjusted hazard ratio, ODI : oxygen desaturation index, COPD: chronic obstructive pulmonary disease, CAD: coronary artery disease, PVD: peripheral vascular disease, HR: hazard ratio, CI: confidence interval, CT: cumulative time, $SpO_2$: oxyhemoglobin saturation.*P<0.05, **P<0.01.

Back to Abstract Table of Contents

# Life-Threatening Events During Hospitalization: A Retrospective Study of Patients Treated with Naloxone

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## ABSTRACT

**Background**. We describe the clinical course of medical and surgical patients who received naloxone on general hospital wards for suspected opioid-induced respiratory depression (OIRD). Our main aim is to compare medicine and surgical patients administered naloxone in the general wards regarding incidence, clinical characteristics, and subsequent course.

**Methods**. We retrospectively searched the institutional medical records (IRB #20-011580) from May 5, 2018, through October 31, 2020, to identify patients ≥18 years old, who received naloxone on the general care wards. Patients were excluded if naloxone was administered in a monitored setting (intensive care unit, post-anesthesia care unit), or if they received naloxone as part of a medical protocol for indications other than OIRD, or did not provide prior written informed consent for inclusion in retrospective studies.

**Results**. There were 86,030 medical and 106,807 surgical admissions. Naloxone was administered to 99 medical and 63 surgical patients with an incidence (*per* 10,000 admissions) of 11.5 [95%CI 9.4–14.0] for medical, and 5.9 [95%CI 4.5–7.5] for surgical patients, P<0.001. Median [IQR] oral morphine equivalents administered within 24-hour before naloxone were 32 [15, 64] and 60 [32, 88] mg for medical and surgical patients, respectively, P=0.002. Opioid administration route differed, with more surgical patients receiving oral opioids (P=0.011) and more medical patients receiving it via transdermal route (P=0.044). Regarding to the clinical presentation the medical notes indicated presence of neurologic signs/symptoms in 129 (79.6%), cardiovascular signs/symptoms in 91 (26.5%), and pulmonary signs/symptoms in 81 (50.0%) of patients. In both groups, assessments preceding the event were consistent with light sedation (median RASS -2) and with moderately severe pain (median NPRS ≥5). From 110 patients (68 medical, 42 surgical) with both RASS and NPRS recorded at the nursing assessment preceding naloxone administration, 18% (20/110 [18%], 13/68 [19%] medical, 7/42 [17%] surgical) had ‘pain-sedation mismatch’ (RASS ≤ -3 and NPRS ≥ 5). The rapid response

team was activated in 111 (68.5%) events, and 81 (50.0%) patients were transferred to the critical care unit. In-hospital mortality was 21 (21.2%) *vs.* 2 (3.2%) and discharge to hospice 12 (12.1%) vs. 1 (1.6%), for medical and surgical patients respectively, P=0.001. In-hospital mortality was 21.2% and 3.2% for medical and surgical patients, respectively; more medical than surgical patients were discharged to hospice; and overall, 30-day mortality was 29.3% and 3.2% for medical and surgical patients, respectively P<0.001.

**Conclusion**. In our practice the rate of naloxone administration on hospital wards was low. Medical inpatients are more likely to suffer OIRD than surgical inpatients despite lower opioid doses. Also, the clinical outcomes of medical patients administered naloxone was less favorable than surgical patients.

**Table 1.** Comparison of baseline characteristics, event circumstances and outcomes of medical and surgical hospitalized patients administered naloxone.

| Variable | Medical patients N= 99 | Surgical patients N=63 | P |
|---|---|---|---|
| **Baseline characteristics** | | | |
| Age, years | 64.5 ± 18.3 | 67.1 ± 11.9 | 0.325 |
| Male sex | 39 (39.4) | 23 (36.5) | 0.743 |
| Body mass index, kg/m$^2$ | 30.2 ± 10.6 | 28.2 ± 6.6 | 0.175 |
| Charlson comorbidity index | 5 [3, 8] | 4 [2, 7] | 0.110 |
| PRODIGY score, High risk | 62 (62.6) | 42 (66.7) | 0.612 |
| Obstructive sleep apnea* | 21 (21.2) | 35 (55.6) | <0.001 |
| Chronic kidney disease | 36 (36.4) | 10 (15.9) | 0.007 |
| *Home medications* | | | |
| Opioids | 26 (26.3) | 5 (7.9) | 0.004 |
| Outpatient methadone | 4 (4.0) | 1 (1.6) | 0.649 |
| Antidepressants | 23 (23.2) | 25 (39.7) | 0.034 |
| Benzodiazepines | 15 (15.2) | 12 (19.1) | 0.524 |
| Gabapentinoids | 34 (34.3) | 28 (44.4) | 0.246 |
| **Opioid and other medication administration prior to naloxone administration** | | | |
| Time from admission to naloxone, hours | 41 [15, 129] | 57 [33, 117] | 0.141 |
| Total opioid dose 24-hr before naloxone, OME, mg† | 32 [15, 63.8] | 60 [31.5, 88] | 0.002 |
| *Other sedative medications* | | | |
| Benzodiazepines | 35 (35.4) | 33 (52.4) | 0.035 |
| Gabapentinoids | 51 (51.5) | 35 (55.6) | 0.632 |
| Zolpidem | 5 (5.1) | 1 (1.6) | 0.406 |
| Haloperidol | 6 (6.1) | 5 (7.9) | 0.752 |
| **Last recorded vital signs before naloxone and description of the event** | | | |
| **Last vital sign before naloxone**, min | 13 [7, 45] | 15 [5, 83] | 0.764 |
| *Clinical presentation*‡ | | | |
| Neurologic‖ | 83 (83.8) | 46 (73.0) | 0.111 |
| Cardiovascular§ | 28 (28.3) | 15 (23.8) | 0.871 |
| Pulmonary** | 53 (53.5) | 28 (44.4) | 0.334 |
| **Interventions and outcomes** | | | |
| Rapid response team | 69 (69.7) | 42 (66.7) | 0.730 |
| Improvement after naloxone | 74 (74.8) | 50 (79.4) | 0.571 |
| Transfer to intensive care unit | 51 (51.5) | 30 (47.6) | 0.747 |
| *Disposition/discharge/outcome* | | | <0.001 |
| Expired in hospital | 19 (19.2) | 2 (3.2) | <0.001 |
| Home | 41 (41.4) | 42 (66.7) | |

| | | | |
|---|---|---|---|
| Hospice | 11 (11.1) | 1 (1.6) | |
| Left against medical advice | 0 (0.0) | 1 (1.6) | |
| Skilled nurse facility | 28 (28.3) | 17 (27.0) | |
| 30-day mortality†† | 29 (29.3) | 2 (3.2) | <0.001 |

Categorical variables are summarized using number (percent) and compared between groups using Fisher's exact test. Continuous variables are summarized using mean ± SD, or median [25%, 75% interquartile range], and compared between groups using the two-sample t-test, or Kruskal-Wallis test.

*Abbreviations*: PRODIGY = PRediction of Opioid-induced respiratory Depression In patients monitored by capnoGraphY, OME = Oral morphine equivalents

*We speculate the lower rate of OSA among the medical patients represents an underestimate as surgical patients are routinely screened for OSA, and medical patients not.

†Oral Morphine Equivalents (OME) were calculated with the opioids administrated during 24 hours before naloxone administration. Thirty-six patients in the medical group and 9 surgical patients received naloxone within 24 hours from admission, opioids were recorded during that time.

‡Patients frequently had multiple presenting signs recorded by healthcare teams in the clinical notes.

‖ Neurologic: Somnolence ( 29 medical and 10 surgical); mental status change (31 medical and 17 surgical); unresponsiveness (39 medical and 21 surgical); seizures (2 medical and 2 surgical); involuntary movements (3 medical and 5 surgical); and pinpoint pupils (15 medical and 6 surgical).

§Cardiovascular: pulseless (3 medical patients); tachycardia (6 medical and 2 surgical); hypotension (18 medical and 12 surgical); bradycardia (6 medical and 3 surgical); and hypertension (2 surgical).

**Pulmonary: Hypoxemia (26 medical and 12 surgical); bradypnea (22 medical and 14 surgical); apnea (10 medical and 4 surgical); and Labored/distressed breathing (5 medical and 4 surgical).

††Defined as 30 days from hospital admission for medical patients and 30 days from surgery for surgical patients.

Title: Prevention of delirium in elderly with obstructive sleep apnea (PODESA): A randomized controlled trial

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Background: Delirium is a common problem that occurs in 5-50% of older adults following surgery. Patients who develop delirium after surgery are at increased risk for morbidity and mortality. It is unclear whether obstructive sleep apnea (OSA) increases risk of postoperative delirium and whether treatment is protective.

General Aims: Our objectives were to identify OSA preoperatively with a portable home sleep study and to determine whether auto-titrating continuous positive airway pressure (APAP) would decrease the incidence of postoperative delirium in older adults undergoing elective hip or knee replacement surgery.

Methods: This was a multi-centre, prospective, randomized controlled trial that was conducted at three academic hospitals in Canada. Research ethics board approval was obtained from the participating sites and informed consent was obtained from participants. Inclusion criteria were patients who were: 1) 60 years and older; 2) scheduled for elective hip or knee replacement surgery 3) possessed the cognitive and physical capability necessary to comprehend and complete the study questionnaires; 4) proficient in English; 5) accessible for follow-up; and 6) able to provide informed consent. Patients with central sleep apnea, significant cardiac, respiratory, or psychiatric disease, a prior diagnosis of sleep-related breathing disorder who were compliant with CPAP/APAP were excluded. Patients with a STOP-Bang score of $\geq$3 had a portable home sleep study with ApneaLink$^{TM}$ Air (ResMed, San Diego, California, USA) for one night. Patients were defined as having OSA if the apnea-hypopnea index (AHI) was $\geq$ 10/h. These patients were randomized 1:1 to either 1) intervention (APAP) or 2) control (usual care) group after surgery. The primary outcome was postoperative delirium based on the Confusion Assessment Method (CAM) twice daily for 72 hours or until discharge if hospital stay >72 hours. The secondary outcome measures included length of stay, and perioperative complications occurring within 30 days after surgery. Differences in the primary and secondary outcomes were assessed using parametric and non-parametric tests where appropriate, and a P-value <0.05 was considered statistically significant.

Results: There was no difference in baseline characteristics between the two groups. The mean age was 68.2 (6.2) years, 58.6% were male and the mean body mass index was 33.3(6.3) kg/m$^2$. Of the 549 patients who were assessed for eligibility, 474 with a STOP-Bang score ≥3 underwent a home sleep study with ApneaLink Air™. A total of 234 patients identified as having OSA were randomized. Eight patients in the treatment group and 6 patients in the control group were lost to follow-up or discontinued participation. Analysis was performed on a total of 220 patients. Five (4.4%) patients in the usual care group, and one patient (0.9%) in the treatment group who was not adherent with APAP developed postoperative delirium (P=0.24). The mean length of stay for the APAP vs. usual care group was 2.9 (2.9) days vs. 3.5 (4.5) days, P=0.24, respectively. There was no difference in intraoperative and postoperative complications between the two groups.

Conclusion: APAP did not decrease the incidence of postoperative delirium in older adults with newly diagnosed OSA undergoing elective knee or hip arthroplasty.

**ABSTRACT TITLE: INVESTIGATING ASSOCIATIONS BETWEEN RACE AND OPIOID INDUCED RESPIRATORY DEPRESSION – A MULTINATIONAL POST-HOC ANALYSIS OF THE PRODIGY TRIAL**

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## BACKGROUND

Opioid induced respiratory depression (OIRD) commonly occurs in up to 46% of patients postoperatively and is associated with significant morbidity and healthcare costs [1,2]. While previous studies have investigated various risk factors in the development of OIRD, the role of race remains unclear [2,3].

## GENERAL AIM

We aim to investigate the association between race and the incidence of postoperative OIRD.

## MATERIALS AND METHODS

This is a post-hoc analysis of the PRODIGY trial; a prospective multinational observational blinded study [2]. Appropriate ethics approval was obtained.

1253 general ward patients with complete data on race, from 3 continents receiving postoperative parenteral opioids were recruited from 2017-2018. Continuous capnography and oximetry (Capnostream™ 20p or 35 portable respiratory monitor, Medtronic) were instituted for a median of 24 hours.

The primary outcome was the incidence of postoperative respiratory depression (RD), defined as the occurrence of ≥1 of the following: 1)Respiratory rate of ≤5 breaths/minute for ≥3 minutes 2)Oxygen saturation of ≤85% for ≥3 minutes 3)End-tidal carbon dioxide

≤15mmhg or ≥60mmhg for ≥3 minutes 4)Apnea episode > 30s or 5)Any opioid-related adverse event.

Demographic and perioperative data including race and comorbidities were analysed.

Univariate chi-squared and unpaired T-tests were employed. Stepwise selection of all baseline and demographic characteristics was used in the multivariable logistic regression analysis.

**RESULTS**

1253 patients with complete data on racial demographics were included for the post hoc analysis. The incidence of OIRD was 60% in Asians, 25% in Blacks, 43% in Whites, and 45% in patients of Other races

Baseline characteristics varied significantly amongst the races. Asians tended to be older ($p< 0.001$), opioid naïve ($p< 0.001$), and have higher opioid requirements ($p<0.001$). Blacks tended to have a higher incidence of heart failure ($p=0.008$), obesity ($p<0.001$) and smoking ($p=0.02$).

Stepwise multivariable logistic regression (Figure 1) of all significant factors revealed that Asians had significantly increased risk of RD when compared to Blacks (OR 2.49, 95% C.I. 1.54-4.04, $p=0.0002$) and Whites (OR 1.38, 95% C.I. 1.01-1.87, $p=0.0432$). Whites had a higher risk of RD compared to Blacks (OR1.81, 95% C.I. 1.18-2.78, $p=0.0067$). The model's Area Under the Curve was 0.760 (95% C.I. 0.733-0.787), with a Hosmer-Lemeshow goodness-of-fit test p-value of 0.23.

**DISCUSSION**

We found a novel association between Asian race and an increased risk of postoperative OIRD as compared with Whites and Blacks. Several postulated mechanisms may explain our findings. Current literature has reported ethnic genetic variations in Mu receptors and CYP3A4 enzymatic activity which may increase the susceptibility of Asians to OIRD [4,5]. However, these findings may also be reflective of known racial differences in craniofacial structure and higher prevalence of undiagnosed and severe OSA amongst Asians [6,7,8].

**CONCLUSION**

This post-hoc analysis of the PRODIGY study found a novel association between Asian race and increased incidence of OIRD, as compared with Whites and Blacks. Further study is required to elucidate its underlying mechanisms, to facilitate targeted care pathways and reduce OIRD in susceptible patient populations.

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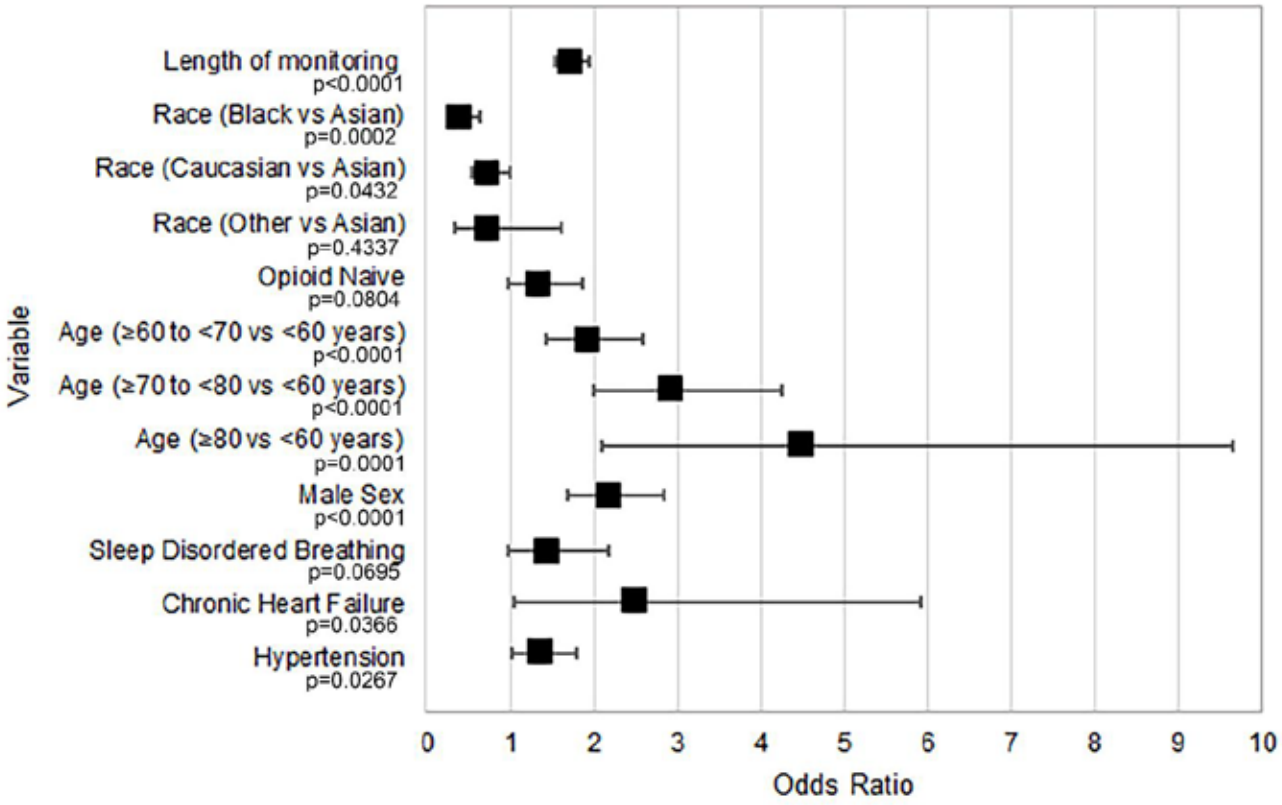
Figure 1. Multivariate model for respiratory depression occurrence.



**Abstract Title:** Using Oxygen Desaturation Index to predict Respiratory Depression in Post-Surgical patients receiving opioids. A post hoc analysis from The Prediction of Opioid-induced respiratory Depression in patients monitored by capnoGrapY (PRODIGY) study.

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**Abstract Content:**

**Background:** Opioid induced respiratory depression (OIRD) can lead to respiratory failure, resulting in severe morbidity and mortality, particularly during the post-operative period.[1] The most commonly available monitoring modality for respiratory events is using a pulse oximeter. Oxygen desaturation index (ODI) can be computed solely by continuous pulse oximetry monitoring.[2] ODI at varying cutoffs has been shown to predict obstructive sleep apnea severity[3]. We would like to investigate if ODI can also be used to predict OIRD.

**General Aim:** To evaluate the utility of nocturnal oximetry patterns, specifically, ODI to predict respiratory depression

**Materials and Methods:** The PRODIGY trial (NCT02811302) was conducted in 2017-2018 at 16 sites in Asia, Europe, and the United States. Eligible patients included adults who were anticipated to receive parenteral opioids on the general care floor following surgery or a medical procedure.[4] Patients were monitored by blinded pulse oximetry and capnography monitoring (Capnostream™ 20p bedside monitor or 35 portable respiratory monitor with Nellcor™ pulse oximetry, Medtronic, Boulder, CO), alongside standard of care monitoring per trial site. A respiratory depression episode was defined as: respiratory rate ≤5 breaths/min for ≥3 minutes, oxygen saturation ($SpO_2$) ≤85% for ≥3 minutes, end-tidal carbon dioxide ($EtCO_2$) ≤15 or ≥60mmHg for ≥3 minutes, apnea episode lasting >30 seconds, or any respiratory opioid-related adverse event.[4] Pulse oximetry and capnography data for each patient were reviewed by an independent clinical event committee to confirm the presence or absence of ≥1 respiratory depression episode. $ODI_{4\%}$ was calculated based on desaturation episodes defined by a 4% decrease in saturation from the average blood oxygen saturation in the past 120 seconds, lasting at least 10 seconds.[2] ODI4% cut-off was set at ≥15 episodes/hour.[3] Logistic regression and area under the receiver operating characteristic curve (AUC) were computed with SAS 9.4.

**Results:** A final cohort of 1,072 (out of 1,335) patients had monitoring data between 12am and 6am, and 76% of them had ≥1 episode of ODI4%. The average length of monitoring was 5.6±1.1 hours.

Multivariable logistic regression showed that geographic location, opioid naïvety, age, male sex, sleep disordered breathing, and ODI4% were strongly associated with respiratory depression (Table 1). Odds ratio for ODI4% was 4.71 (95% CI 1.93-11.47, adjusted p=0.0006). AUC for this model was 0.723 (0.691-0.754). However, absolute $SpO_2$ cut-offs (≤80% or ≤90%) were not significantly associated with respiratory depression.

**Discussion:** OIRD and hypoxemia remain significant problems (76% of patients had ≥1 episode of ODI4%). In most institutions, oximetry is monitored on the general care floor at intervals of 4 hours after the patient is deemed stable. An adverse respiratory event could then occur at the time interval the patient is between monitoring cycles. ODI4% was an independent predictor of OIRD during the postoperative period. It may help with identifying patients at risks of OIRD and thus arrange close postoperative monitoring for those patients.

**Conclusion:** Patients with a higher ODI4% of ≥15 episodes per hour are at higher risk of developing OIRD and should be monitored closely.

**Table 1:** Multivariable logistic regression model to evaluate the association between RD occurrence and oxygen desaturation episodes using ODI4% occurring ≥15 episodes per hour

| Parameter | Estimate | Standard Error | Odds Ratio | 95% Wald CI | | p-value |
|---|---|---|---|---|---|---|
| | | | | Lower CI | Upper CI | |
| **Length of monitoring (overnight hours)** | 0.2078 | 0.0667 | 1.231 | 1.08 | 1.403 | 0.0018 |
| **Geography (United States vs Asia)** | 0.5061 | 0.174 | 1.659 | 1.18 | 2.333 | 0.0036 |
| **Geography (United States vs Europe)** | 0.1047 | 0.193 | 1.11 | 0.761 | 1.621 | 0.5875 |
| **Opioid Naive** | 0.3514 | 0.1853 | 1.421 | 0.988 | 2.043 | 0.058 |
| **Age (≥60 to <70 vs <60)** | 0.8375 | 0.1584 | 2.311 | 1.694 | 3.151 | <0.0001 |
| **Age (≥70 to <80 vs <60)** | 1.3466 | 0.1985 | 3.844 | 2.605 | 5.673 | <0.0001 |
| **Age (≥80 vs <60)** | 1.8541 | 0.4206 | 6.386 | 2.801 | 14.562 | <0.0001 |
| **Male Sex** | 0.7393 | 0.1396 | 2.095 | 1.593 | 2.753 | <0.0001 |
| **Sleep Disordered Breathing** | 0.4261 | 0.2207 | 1.531 | 0.994 | 2.36 | 0.0535 |
| **Chronic Heart Failure** | 0.6004 | 0.4449 | 1.823 | 0.762 | 4.359 | 0.1771 |
| **$ODI_{4\%}$ (<15 vs ≥15) episodes/hr** | **1.5496** | **0.4541** | **4.71** | **1.934** | **11.469** | **0.0006** |
| | | | | | | |
| **Hosmer-Lemeshow p-value** | 0.71 | | | | | |
| **AUC (95% Wald CI)** | 0.7226 (0.6914-0.7538) | | | | | |

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Back to Abstract Table of Contents

**Abstract Title:** Investigating the effects of short-term spinal cord stimulation on sleep health in patients with refractory neuropathic pain: A state-of-the-art actigraphy analysis

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**Background:** Neuropathic pain (NP) affects 7-18% of the population [1, 2, 3]. In 50-88% of those affected one of the main complaints are difficulties associated with sleep, and for many this cannot be managed through conventional analgesic treatments [4]. Previous research supports the therapeutic effect of spinal cord stimulation (SCS) for individuals suffering from NP [4].

**General Aim:** The intention of this study was to investigate the effect of short-term SCS on the sleeping patterns of males and females suffering from NP using raw-data based actigraphy.

**Materials and Methods:** Following REB approval, adults 18-80 years of age, with NP in their back and/or lower limbs were enrolled. Participants underwent percutaneous SCS for a minimum of 7 days. To investigate the effects of SCS on sleep, participants wore an Actigraphy device (GENEActiv; 50 Hz) for the duration of the trial. Sleep metrics were derived from the raw data [5] and included, total sleep time (TST; in minutes), sleep efficiency (SE; as a %) and wake after sleep onset (WASO; in minutes). The SCS was deemed successful for participants if a 50% reduction in intensity of pain was achieved by Numerical Rating Scale, compared to baseline. Univariate analyses were run to determine whether the sleep metrics were different between the successful and unsuccessful participants. Following which, a mixed-model ANOVA was used to compare the metrics in males and females at baseline (night 1) and follow-up (night 7).

**Results:** From the 149 participants that were enrolled, 106 were found to have valid actigraphy data. From the 49 females (49.96 ±12.74 years), the trial was successful for 34. From the 57 (54.81 ± 13.32 years) males, 38 were found to be successful. The univariate analyses did not reveal any significant differences between the successful and unsuccessful trial participants. According to the mixed-model ANOVA, a significant main effect of time-point was found for TST $F(1.00, 104)= 15.522$ ($p<0.001$; Figure 1A) and WASO $F(1.00, 104)= 4.001$ ($p=0.048$; Figure 1C). The pairwise comparison revealed that both TST and WASO were significantly reduced at follow-up. Additionally, a significant main effect of sex was found for TST $F(1.00, 104)= 4.322$ ($p=0.040$; Figure 1A) and SE $F(1.00, 104)= 4.10$ ($p=0.038$; Figure 1B). The pairwise comparison indicated females had greater TST and SE. No interaction effects were found.

**Discussion:** The results from this study demonstrate that SCS significantly improves the sleep of individuals suffering from NP, as exhibited by a reduction in WASO. Findings are consistent with the results of previous studies that have examined this relationship using proprietary count-based actigraphy or subjective techniques [4, 6].

**Conclusion:** To our knowledge, this is the first study to comprehensively examine sleep health domains using actigraphy in individuals with NP before and after undergoing a SCS trial using raw actigraphy data. Future research should investigate whether these improvements in sleep are maintained long-term, and result in improved functional and quality of life outcomes.

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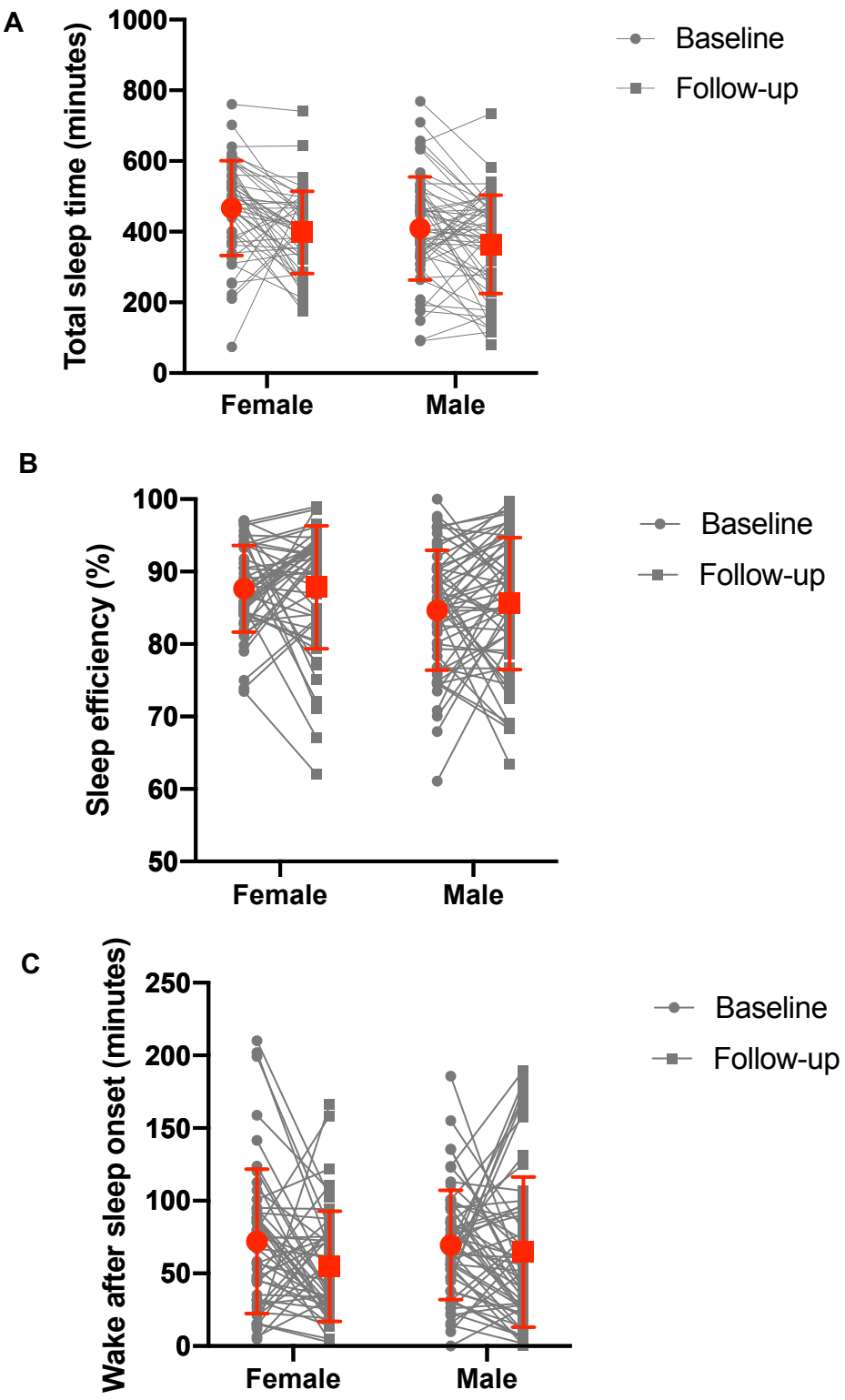


**Figure 1:** Total sleep time (TST; **A**), sleep efficiency (SE; **B**), wake after sleep onset (WASO; **C**) at baseline and follow-up by sex. Individual values are in grey, population means are pictured in red.

Abstract Title:
"The Creation, Implementation, and Participation in a Novel Anesthesia Elective in Sleep Medicine at the University of Virginia"

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Background:
Anesthesiology and sleep medicine share many features – both specialties deal with the physiology of unconsciousness, and both witness firsthand the medical consequences of sleep disordered breathing. Anesthesiologists are often the first to recognize sleep disordered breathing perioperatively, as many of these conditions (such as obstructive sleep apnea) remain underdiagnosed and are more evident after a general anesthetic.[1] Furthermore, many sleep disorders, including obstructive sleep apnea, significantly increase perioperative risk, both directly (increased upper airway collapse, increased probability of a difficult airway) and indirectly (increased medical comorbidities including pulmonary hypertension, coronary artery disease, and metabolic disease).[2] However, despite the significant overlap between specialties, the Accreditation Council for Graduate Medical Education (ACGME) and American Board of Anesthesiology (ABA) do not require residency programs to offer any formal training in sleep medicine, or even a sleep elective. Furthermore, due to the highly structured nature of the ACGME and ABA's residency requirements, offering new electives in specialties traditionally thought of as being "outside of anesthesiology" can be difficult.

General Aim:
At the University of Virginia (UVA Health), the Department of Anesthesiology and the Department of Pulmonology, Critical Care, and Sleep Medicine sought to work together to implement an elective for interested anesthesiology residents.

Methods:
This elective consisted of one week of training in sleep medicine, with an example rotation shown below:

Rotation Schedule

| | Monday | Tuesday | Wednesday | Thursday | Friday |
|---|---|---|---|---|---|
| AM | Introduction to sleep medicine, polysomnography (PSG), home sleep tests (HST) | Sleep Medicine Clinic | Sleep Medicine Clinic | HST reading with sleep physician | Preoperative Anesthesia Clinic |
| PM | Sleep Center Orientation | Sleep Medicine Clinic | PSG reading with sleep physician | Sleep Medicine Clinic | Discussion of current sleep medicine literature |

The above schedule was designed to provide an anesthesiology resident a broad overview of sleep medicine in a truncated timetable. The introductory day consisted of directed readings and discussion, followed by an orientation to the sleep center. Rotating through the sleep clinic allowed the resident to evaluate and treat patients for sleep disorders under the supervision of a sleep physician. This was followed by polysomnography and home sleep test readings with a sleep physician later in the week. The resident had the opportunity to apply this to the practice of anesthesiology on the final day of the rotation.

Results / Discussion:
This elective has been successful in its early stages with one resident choosing to pursue fellowship training after completion of the elective. The collaboration between the departments has been implemented as an elective rotation for senior anesthesiology residents at UVA Health. This could serve as a model for other anesthesiology residency programs looking to provide resident training in sleep medicine.

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**Becoming dual-credentialed in anesthesia and sleep medicine – Surveying the interest of North American anesthesia "trainees" and surveying careers of current physicians.**

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## Background

Sleep medicine is a vital part of clinical practice for many medical specialties. Sleep disorders can have a direct impact on perioperative patient outcomes, longer hospital stays and increased mortality.[1,2] Anesthesiologists in particular commonly find themselves managing patients with various sleep disorders for perioperative patient management, and as such there is interest to incorporate sleep medicine-related training in the residency curriculum.[3,4] Recently, residents who have American Board of Anesthesiology training are eligible to partake in an accredited 1-year ACGME (Accreditation Council of Graduate Medical Education) fellowship for Sleep Medicine to expand their scope of practice, and explore their interests.[5,6,7,8]

## General Aim

This prospective needs assessment survey focuses on assessing the interest of anesthesia "trainees", including both current residents and fellows that have completed anesthesia residency, in pursuing a sleep medicine fellowship, along with assessing the careers of current dual-credentialed physicians in these specialties.

## Materials and Methods

A two-stream survey was generated via the *Qualtrics* platform, and the link was disseminated by the Canadian Anesthesiologists Society (CAS) to anesthesia trainees (16 questions) and dual-credentialed physicians (25 questions) across North America. The survey covered topics including demographics, sleep medicine as a specialty, current job satisfaction, experience and certification, job satisfaction/lifestyle, and skills and benefits of sleep medicine training. A total of 292 responses were received, with 54% of responses from current anesthesia trainees (residents/fellows) in Canada/USA, and 46% from practicing anesthesiologists.

**Results**

Most anesthesia trainees showed interest (60%) in pursuing a fellowship after residency, with 9.7% of trainees showing interest in pursuing a Sleep Medicine fellowship; with desired fellowships included Regional Anesthesia (17%), Pain Medicine (16%), and Cardiac Anesthesia (15%). Additionally, 62% of trainees were unaware of Sleep Medicine as a sub-specialty training option for anesthesiologists, and only a minority (7%) of trainees identified having had direct exposure to Sleep Medicine clinical practice during their training (see Figure 1). Over one-third of trainees (39%) identified insufficient residency training as the primary barrier to understanding and managing sleep-related disorders. Going forward, mentorship was identified as the most useful method of support/direction in increasing interest in Sleep Medicine.

Dual-credentialed physicians in anesthesiology and sleep medicine, the survey was primarily completed by anesthesiologists without a sleep medicine focus (87%), with 4% being dual-credentialed in sleep medicine/anesthesia and 9% having an academic interest in sleep medicine. A reported 30% of anesthesiologists were “likely”/”very likely” to recommend training in Sleep Medicine, while 39% were neutral in their recommendation. Anesthesiologists identified limited resources at hospitals/clinics (27%) and insufficient residency training (25%) as barriers to understanding/managing sleep related disorders.

**Discussion/Conclusion**

Preliminary results indicate that majority of anesthesia trainees were unaware of Sleep Medicine as a sub-specialty training opportunity, with a notable lack of exposure to Sleep Medicine during residency training. A minority of anesthesia trainees (6%) indicated being likely to pursue a Sleep Medicine fellowship at this time. Trainees cited a need for increased residency training opportunities to improve competency in managing sleep related disorders, and increased mentorship to explore Sleep Medicine as a career opportunity.

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Back to Abstract Table of Contents

## Appendix

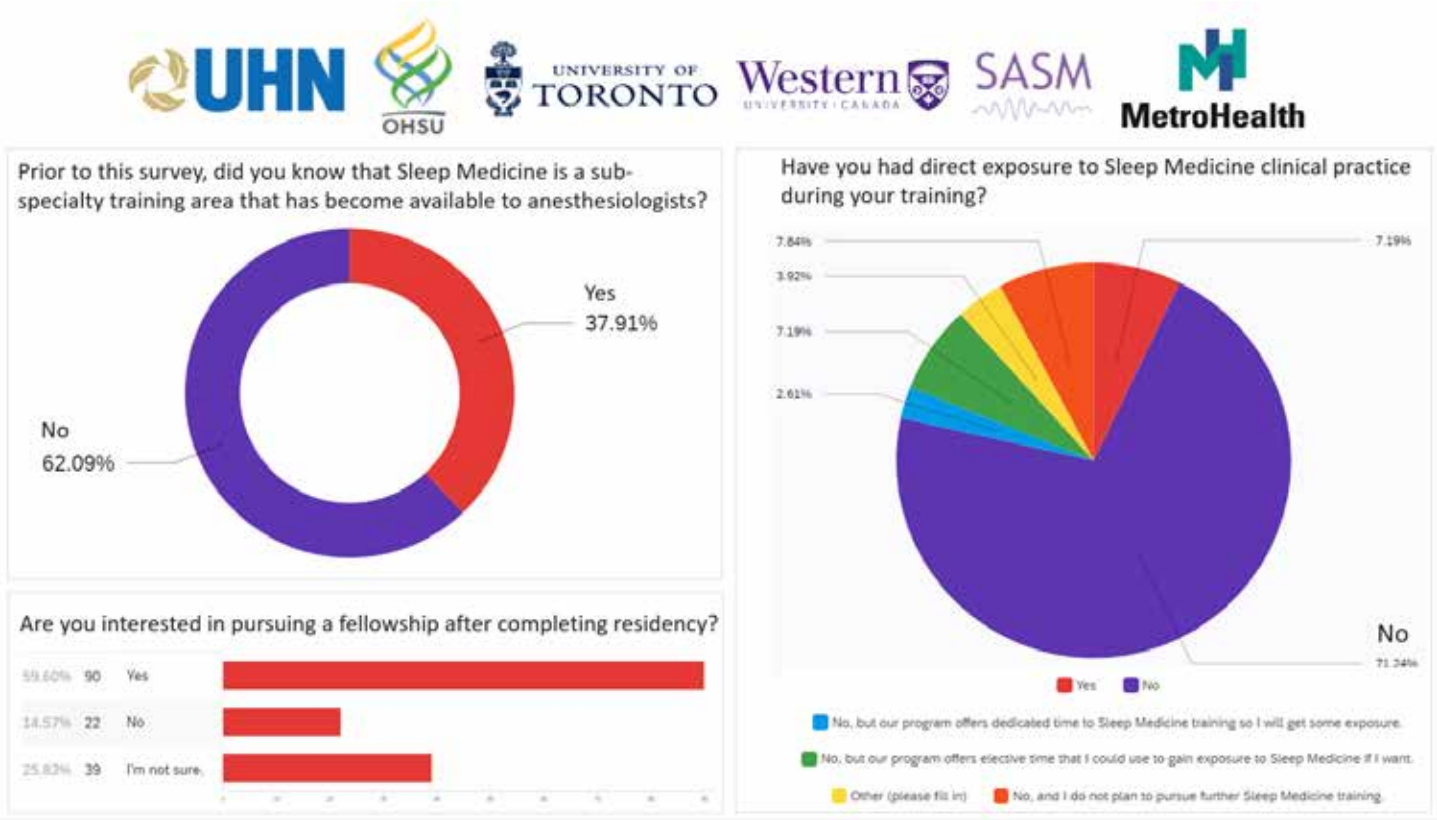


Figure 1 – Majority (60%) of anesthesia trainees were interested in pursuing a fellowship post-residency, however a majority (62%) were unaware of Sleep Medicine as a sub-specialty training option for anesthesiologists. Only a minority (7%) of anesthesia trainees have had direct exposure to Sleep Medicine clinical practice during training.

**Positive expiratory pressure therapy on oxygen saturation and ventilation after abdominal surgery: A randomized controlled trial**

**Background:** Positive expiratory pressure therapy to treat postoperative hypoxia after surgery is widespread, despite a lack of evidence of effect.

**General Aim:** To evaluate the immediate effects of positive expiratory pressure therapy on oxygen saturation and ventilation after abdominal surgery.

**Material and Methods:** This randomized, sham-controlled, crossover trial investigated adults one to two days after abdominal surgery at Umeå University Hospital, Sweden. The intervention was positive expiratory pressure of 10-15 cm $H_2O$. The control was a sham device. The investigations were ended with deep-breathing maneuvers. Outcomes were the gradient of changes in peripheral oxygen saturation and transcutaneous carbon-dioxide partial pressure ($PtcCO_2$). The study was approved by the Regional Ethics Committee at Umeå University, Sweden

**Results:** Eighty patients were included and randomized and 76 patients were analyzed. Oxygen saturation increased from a baseline mean of 92% to 95%, $p < 0.001$, during positive expiratory pressure breathing, while $PtcCO_2$ decreased from a mean of 36 mmHg to 33 mmHg, $p < 0.001$. This was followed by central apnea, oxygen desaturations to a mean of 89%, $p < 0.001$, and increased $PtcCO_2$ before returning to baseline values. The changes in oxygen saturation and $PtcCO_2$ did not differ from sham breathing or deep-breathing maneuvers (Figure).

**Conclusions:** Positive expiratory pressure breathing maneuvers after abdominal surgery improve oxygen saturation because of hyperventilation, but are followed by apnea, hypoventilation and oxygen desaturations. The effect is not different from the expiration to a sham-device or hyperventilation. It is time to stop positive expiratory pressure therapy after abdominal surgery, as there is no evidence of effect in previous trials, apart from the adverse effects reported here.

Back to Abstract Table of Contents

**Abstract Title:** Investigating the effects of applying different raw Actigraphy processing approaches to examine the sleep data in a neuropathic pain population

**Presenting Author:** Hannah J. Coyle-Asbil, MSc[1,2]
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**Background:** Difficulties associated with sleep, are commonly reported by those suffering from Neuropathic pain (NP) [1]. Actigraphy has previous been used to measure sleep in this population [1]. Count-based analyses are predominantly used to examine actigraphy data, however due to the proprietary nature, many researchers are moving towards quantifying acceleration data in its raw form [2]. However, various processing techniques exist to accomplish this, and it remains unclear how they compare to one another.

**General Aim:** This study sought to compare sleep outcome measures derived according to the GGIR R package versus the GENEActiv (GA) R markdown tool.

**Materials and Methods:** Adults 18-80 years of age, with NP in their back and/or lower limbs were enrolled following REB approval. Participants were asked to wear an Actigraphy device on their wrist while receiving percutaneous spinal cord stimulation for a minimum of 7 days (GENEActiv; 50 Hz). Upon completion of the study protocol, sleep outcome measures were calculated using i) the GGIR R package [3] and ii) the GA R Markdown tool provided by the manufacturer. To compare the algorithms various Sleep metrics were exported including total sleep time (TST; in minutes), sleep efficiency (SE; as a %), wake after sleep onset (WASO; in minutes), sleep onset time and and rise times (hours after midnight of the previous day). Paired-samples *t* tests were used to compare the algorithms. To assess the limits of agreement results were then displayed in Bland-Altman plots.

**Results:** From the 149 participants that were enrolled, 112 were found to have valid actigraphy data (mean age= 52.72 ± 13.01 years; 60 M). The paired samples *t* test revealed that TST and SE were significantly reduced when calculated using the GA R Markdown (366.73 ± 135.61; 67.68 ± 12.43%) compared to the GGIR R package (mean= 416.84 ± 125.97 minutes, t(1028) = -15.48, p= <0.001; mean= 86.80 ± 8.26 %; t(1028)= -54.69, p= <0.001). Accordingly, WASO was significantly greater when calculated using the GA R Markdown tool (mean= 178.86 ± 110.28 minutes) in contrast to the GGIR R package (mean= 64.37 ± 45.13 minutes; t(1028) = 33.68, p= <0.001). Later sleep onset times (mean= 23.45 ± 2.57 hours) and earlier rise times (31.47 ± 2.67 hours) were reported by GGIR compared to the GA R Markdown (mean= 23.07 ± 2.84 hours, t(1028)= -5.09, p= <0.001; mean= 32.09 ± 3.07 hours, t(1028)= 8.49, p= <0.001). Results from the Bland-Altman analyses are displayed in Figure 1.

**Discussion:** This study demonstrates that these algorithms are not interchangeable; compared to the GGIR R package, the GA R Markdown tool communicates significantly poorer sleep outcomes. These findings indicate that results should not be compared between studies that have used algorithms to measure sleep.

**Conclusion:** To our knowledge, this is the first study to directly compare these raw-based sleep algorithms. To determine which algorithm is more accurate in its reporting, future research should investigate these results in reference to polysomnography.

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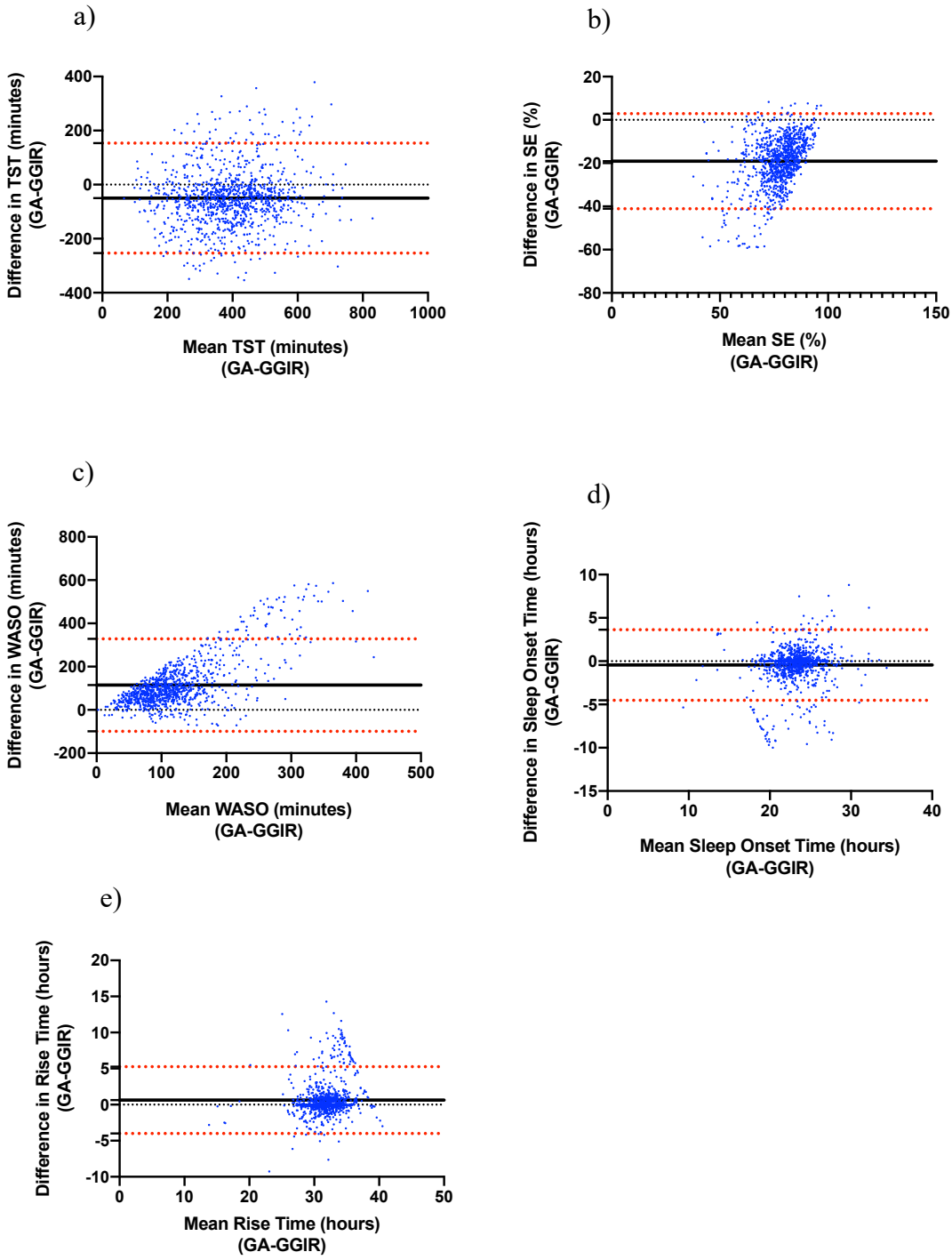


**Figure 1:** Bland-Altman plots of the mean difference of a) TST (GA-GGIR), b) SE (GA-GGIR), c) WASO (GA-GGIR), d) sleep onset (GA-GGIR) and e) rise time (GA-GGIR) against the average values of both the processing techniques. The red dashed lines indicate the 95% confidence intervals of the limits of agreement, the solid black line indicates the mean value. A negative value is indicated by a greater value derived using GGIR.

**Title (Full): A Novel Combined Nasal Mask-Face Tent Provided Nasal CPAP Oxygenation and Reduced Aerosol/Droplet Spread in an Obese Patient with Jarcho-Levin Syndrome and an Extremely Difficult Airway during Colonoscopy under MAC: A Case Report**

**Title (Short): Nasal Mask-Face Tent for Jarcho-Levin Syndrome**

**Authors:** Tse J, Goyal A, Mahajan J, Braslavskaya K, Chiricolo A

**Background:** Amid the COVID-19 pandemic, a simple combined nasal mask-face tent provided continuous oxygenation during GA induction, intubation and extubation and reduced aerosol/droplet spread in a COVID-19 positive patient and a morbidly obese patient(Fig.1-2).[1-3]

We used it to maintain spontaneous nasal CPAP ventilation/oxygenation in a deeply sedated obese patient with rare Jarcho-Levin Syndrome (JLS) and extremely difficult airway during colonoscopy.

**Case Description:** A 21 year-old JLS male, BMI 33.2 $kg/m^2$, with OSA on home CPAP, asthma, respiratory insufficiency, restrictive lung disease and diverticulitis presented for outpatient colonoscopy. He had a Mallampati IV airway and shortened thorax, severe scoliosis/kyphosis and extreme short neck without extension/flexion. He gave consent for photography/case report. A modified infant facemask was secured over his nose and connected to anesthesia machine/circuit delivering 7-10cm$H_2O$ CPAP (4$LO_2$/min)(Fig.3).[1] His $SpO_2$ improved from 97% to 100%. Deep sedation was titrated with lidocaine and propofol boluses and maintained on propofol infusion (150-400 mcg/kg/min). His mouth was covered with a face tent and a suction catheter was secured to reduce aerosol/droplet spread(Fig.4). He maintained spontaneous nasal ventilation and 97-100%$SpO_2$ without the need of any airway manipulation(Fig.5). He required high doses of propofol (overall average: 300mcg/kg/min) for the 30-min procedure. He recovered quickly and was alert and elated.

**Discussion**: This novel nasal mask-face tent maintained spontaneous CPAP ventilation/oxygenation in an obese JLS patient with extremely difficult airway and asthma/respiratory insufficiency during colonoscopy under MAC. Combining with suctioning, it reduced aerosol/droplet spread. It may improve patient safety and provide additional provider protection amid COVID-19 pandemic.

**References**: 1.www.tsemask.com; 2. ASA AM: (MC1280), 2020; 3. NYSSA 74th PGA: MCC201, 2020

Fig. 1. A large, clean plastic sheet is taped to the lower part of the mask.

Fig. 2. Video-laryngoscopy under the face-tent while the nasal mask delivering continuous oxygenation.

Fig. 3. A modified infant mask was secured over the patient's nose with elastic head-straps and connected to the anesthesia machine/circuit.

Fig. 4. A face tent covered the patient's mouth and a suction catheter secured under it.

Fig. 5. The patient maintained 97-100% $SpO_2$ without any airway manipulation.

**A Novel Combined Nasal Mask-Face Tent Provided Pressure-Control Ventilation/Oxygenation and Reduced Aerosol/Droplet Spread for a Super Obese Patient with OHS/OSA during Difficult Colonoscopy/Polypectomy under MAC**

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**Background:** A combined pediatric facemask-face tent provided continuous nasal oxygenation and reduced aerosol/droplet spread during GA induction and intubation/extubation in a COVID-19 positive patient and a morbidly obese patient.[1-3] We used this technique to provide nasal pressure-control ventilation (PCV)/oxygenation in a deeply-sedated super obese patient with obesity hypoventilation syndrome (OHS)/OSA during difficult colonoscopy.

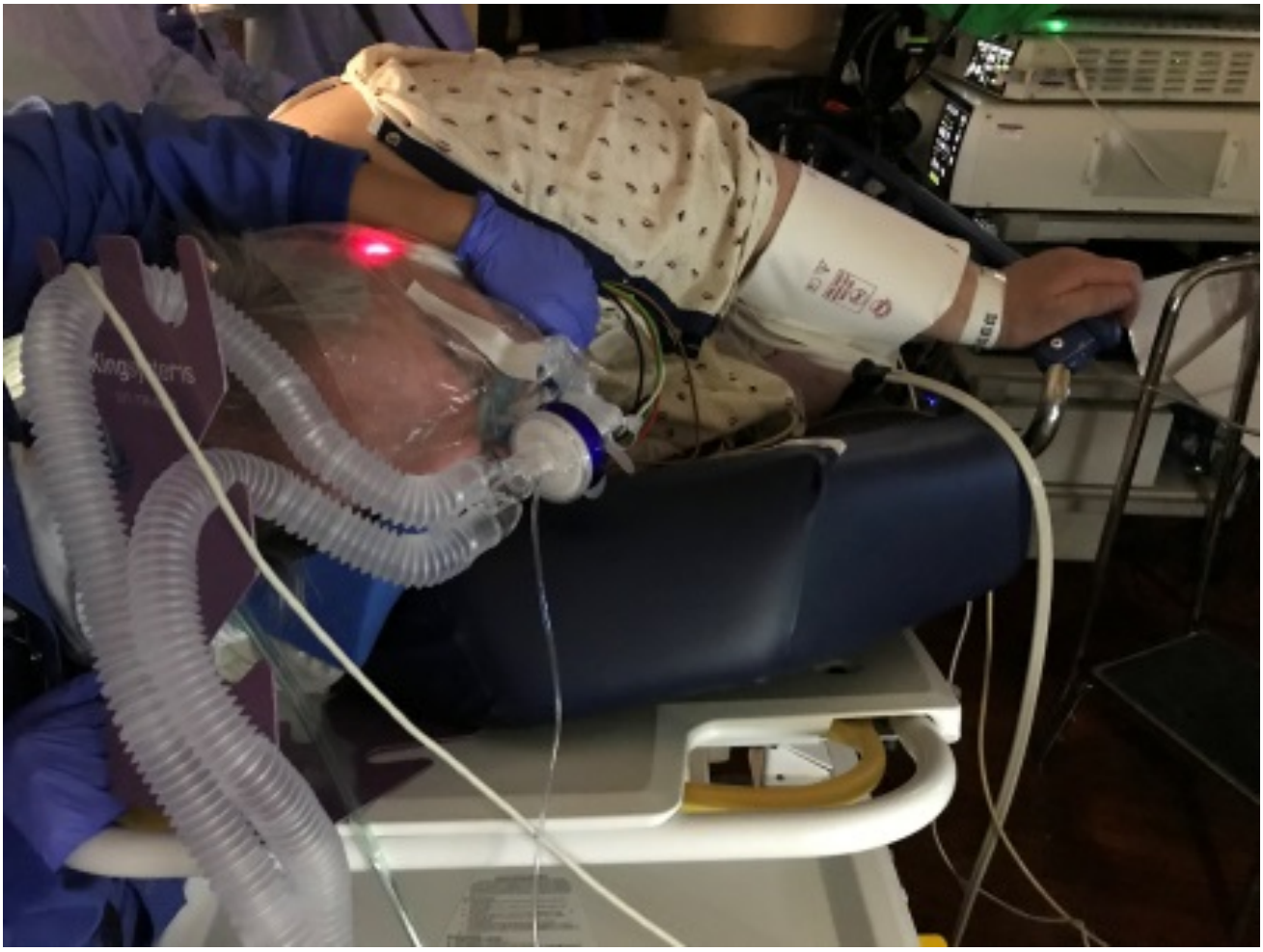
**Case Description:** A 63-year-old smoker, 6', 430 lbs, BMI 58.3 kg/$m^2$, with GERD, Barrett's esophagitis, COPD, OHS/OSA on home BiPAP, and a recent history of delayed emergence and dyspnea post-extubation during failed colonoscopy under GA (6 months prior), presented for repeated colonoscopy/polypectomy. He had a baseline $SpO_2$ of 94% and stated that he breathed best in LLD. He was shown a modified infant facemask and gave his consent for its use, taking photographs and presenting a case report.

An infant facemask-face tent was secured over his nose and connected to the anesthesia circuit/machine delivering 6-8 cm $H_2O$ CPAP with 4L$O_2$/min. Following nasal CPAP pre-oxygenation, his $SpO_2$ improved to 100%. Deep sedation was titrated slowly with lidocaine/propofol and maintained on propofol infusion (150-125 mcg/kg/min). He was then supported with nasal PCV (PIP 15 cm $H_2O$, PEEP 5 cm $H_2O$, RR 11/min). He also received albuterol inhalation treatment delivered via the gas sampling port of the nasal mask.

Advancing the colonoscope was difficult in LLD even with abdominal compressions. He was turned to supine and then RLD. Meanwhile, he required chin-lift and increased PCV support (PIP 18 cm $H_2O$, PEEP 5 cm $H_2O$, RR 16/min) to maintain ventilation and 97-98% $SpO_2$. He tolerated the difficult 3-hr procedure with multiple polypectomies well with stable hemodynamics and 97-98% $SpO_2$. Despite developing emergency agitation, he recovered well with facial BiPAP in PACU and was admitted overnight for observation and BiPAP support. He was discharged home without complications the next day.

**Discussion:** This simple combined nasal mask-face tent provided PCV/oxygenation and reduced aerosol/droplet spread in a superobese patient with OHS/OSA during difficult colonoscopy/polypectomy. It provides additional provider protection at a low cost amid the COVID-19 pandemic.

**References**: 1.www.tsemask.com; 2.ASA AM: MC1280, 2020; 3.NYSSA 74$^{th}$PGA: MCC201, 2020



Chin lift was applied over the face tent in RLD.

**A Novel Combined Nasal Mask-Face Tent Provided Pressure Control Ventilation/Oxygenation and Reduced Aerosol/Droplet Spread while Teaching a Beginning CA1 Resident to Perform Difficult Intubation in an Obese OSA Patient amid the Ongoing COVID-19 Pandemic**

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**Background:** Teaching endotracheal intubation while avoiding desaturation is often stressful for the patient, the trainee and the trainer. Obese patients with OSA and difficult airway pose challenges for teaching intubation. Furthermore, intubation and extubation are aerosol/droplet generating procedures that are of particular concern amid the ongoing COVID-19 pandemic. An infant facemask-face tent provided pre/apneic nasal oxygenationa in a COVID-19 positive patient[1-2] and avoided severe desaturation in a morbidly obese patient.[1-3] Amid COVID-19 pandemic, it reduced aerosol/droplet spread during intubation/extubation.[1-3] We used this simple technique to teach a CA1 resident to perform difficult intubation.

**Case Description:** A 60-year-old male, BMI 35 kg/$m^2$, with OSA on home CPAP, HTN, s/p aortic coarctation repair and AVR, presented for atrial-fibrillation ablation. He had a Mallampati III airway. He gave his consent for photography/case report. An infant facemask-face tent was secured over his nose with elastic head-straps and connected to the anesthesia circuit/machine delivering 6-8 cm $H_2O$ CPAP with 4L $O_2$/min.

Following nasal CPAP pre-oxygenation, GA was induced with midazolam/fentanyl/lidocaine/propofol. After nasal ventilation confirmation with pressure-control ventilation (PCV) (PIP15 cm $H_2O$, PEEP 5 cm $H_2O$, RR 20/min), rocuronium was administrated. Two-hand jaw-thrust was applied to close the mouth and obtain tight seal. Video-laryngoscopy was performed under the face-tent while nasal mask delivered PCV/oxygenation (image). Intubation was accomplished by CA1 resident (3-week training) with assistance. The patient maintained 100-98%$SpO_2$ during the 6-minute induction/intubation. The patient tolerated the procedure well. Prior to extubation, the nasal mask-face tent was re-secured and oral suctioning was performed under face tent to reduce aerosol/droplet spread. Following smooth extubation, he maintained spontaneous CPAP ventilation/oxygenation with nasal mask-face tent. He was elated and had no recalls.

**Discussion:** This simple nasal mask-face tent provided continuous ventilation/oxygenation during intubation/extubation and reduced aerosol/droplet spread in an obese OSA patient undergoing atrial-fibrillation ablation. It allowed extra time needed for teaching difficult intubation. It may improve patient safety and provide additional provider protection at no extra cost amid the ongoing COVID-19 pandemic.

**References:** 1.www.TSEmask.com; 2.ASA AM:MC1280, 2020; 3.NYSSA 74$^{th}$PGA:MCC201, 2020


The nasal mask provided continuous PCV during video-laryngoscopy.

**A Simple Combined Nasal Mask-Face Tent and Oral Suctioning Provided Continuous Oxygenation and Reduced Aerosol/Droplet Spread in an Obese OSA Patient with Previous Severe COVID-19 Pneumonia during POEM**

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Rutgers Robert Wood Johnson Medical School, New Brunswick, NJ

**Background:** Minimization of aerosol/droplet spread, with the goal of providing maximal oxygenation is a primary concern for patients undergoing general anesthesia amid the COVID-19 pandemic.

A pediatric facemask has been shown to provide nasal CPAP ventilation/oxygenation in obese OSA patients.[1-2] A novel combined nasal mask-face tent provided continuous oxygenation and reduced aerosol/droplet spread in a COVID-19 positive patient.[3] It also avoided severe desaturation and reduced aerosol/droplet spread during difficult intubation/extubation in a morbidly obese patient.[4]

We used this simple technique to provide continuous oxygenation and lower aerosol/droplet spread in an obese OSA patient recovered from severe COVID-19 pneumonia undergoing peroral endoscopic myotomy (POEM).

**Case Report:** A 60-year-old obese male with OSA, atrial-fibrillation, cardiomyopathy, severe COPD on home $O_2$, previous severe COVID-19 pneumonia s/p convalescent plasma therapy, and achalasia presented for POEM.

An infant facemask with fully inflated air cushion was secured over his nose with elastic head-straps and connected to the anesthesia machine via a long breathing circuit. His mouth was covered with a clear plastic sheet (face-tent) to reduce aerosol/droplet spread. Following nasal CPAP pre-oxygenation with $4LO_2$/min, RSI with cricoid pressure was induced with lidocaine, etomidate, propofol and succinylcholine. Video-laryngoscopy-assisted intubation was performed under the face-tent while the nasal mask delivered apneic oxygenation. His $SpO_2$ was maintained at 100% throughout induction and intubation.

During the procedure, he developed tension pneumoperitoneum with insufflated $CO_2$ which was reduced with 14G angiocatheter x3 by the endoscopist. Upon conclusion of POEM, the nasal mask-face tent was re-secured over his nose and covered his mouth. After 5 cc of 2% lidocaine spray was delivered through the endotracheal tube (ETT) to reduce coughing, ETT was suctioned clear of secretion under the face tent. The patient resumed spontaneous respiration and his oropharynx was suctioned under the face tent prior to extubation. Post-extubation, he became agitated and required additional propofol, fentanyl and dexmedetomidine and three providers to restrain him in order to maintain spontaneous nasal CPAP ventilation/oxygenation and allow frequent oral suctioning for >20 mins (Image). Subsequently, the patient received nasal cannula $O_2$ with a face tent in PACU and recovered without any complications.

**Discussion:** This simple nasal mask-face tent provided continuous oxygenation during RSI and intubation in an obese OSA patient with previous severe COVID-19 pneumonia undergoing

POEM. It maintained spontaneous nasal CPAP ventilation and oxygenation post-extubation in the patient with emergent delirium. Combining with oral suctioning under the face tent, it reduced aerosol/droplet spread. Amid the ongoing COVID-19 pandemic, it may optimize patient safety and provide additional provider protection at no extra cost.

**References**: 1. www.TSEmask.com; 2. SAMBA 28th AM, MCC, 2013; 3. ASA AM:MC1280, 2020; 4. NYSSA 74th PGA:MCC201, 2020

Post-extubation, the combined nasal mask-face tent maintained spontaneous nasal CPAP ventilation/oxygenation and allowed frequent oral suctioning.

**A Novel Combined Nasal Mask-Face Tent Maintained Spontaneous CPAP Ventilation/Oxygenation and Reduced Aerosol/Droplet Spread in a Frail Elderly Patient with OSA and Severe Cardiopulmonary Diseases during EGD under MAC**

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**Background:** Patients under monitored anesthesia care (MAC) often receive IV sedation and oxygen via a nasal cannula. Over-sedation and/or airway obstruction may result in severe desaturation, especially in obese patients with obstructive sleep apnea (OSA). A simple modified pediatric facemask has been shown to provide nasal CPAP ventilation and improve oxygenation in deeply sedated OSA patients.[1-6]

During the COVID pandemic, a combined nasal mask-face tent has been shown to provide continuous oxygenation and reduce aerosol/droplet spread during GA induction and intubation/extubation in a COVID-19 positive patient and a morbidly obese patient.[7-8]

We used this technique in a frail elderly patient during EGD under MAC.

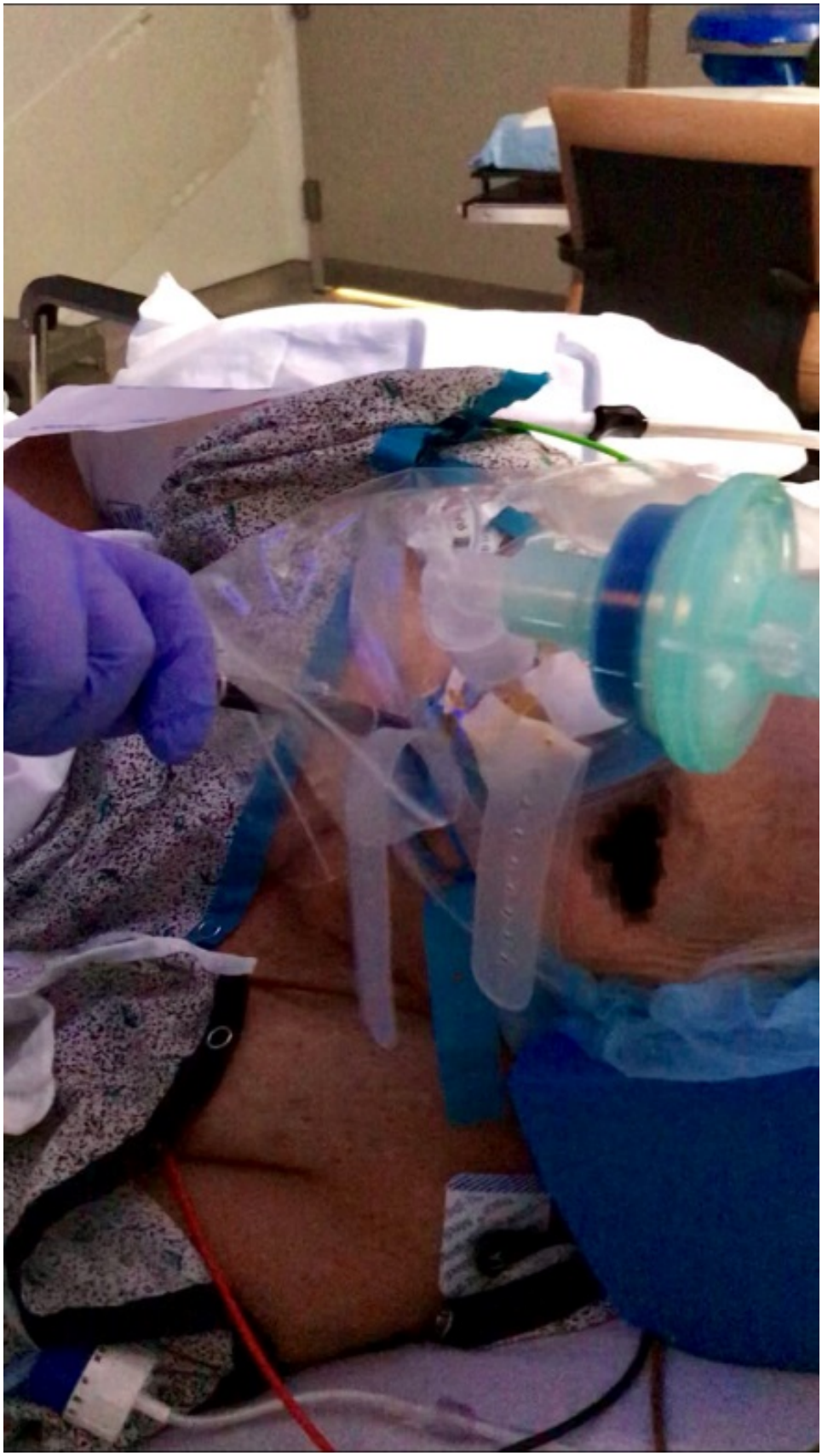
**Case Description:** A 79 year-old female with OSA on home CPAP, COPD, NIDDM, CKD, HTN, hypothyroidism, CAD s/p MI, CABGx3 V, PCIx5 stents, HFrEF (EF 30-35%), history of LVAD, on home milrinone infusion, atrial-fibrillation s/p failed ablation, ischemic cardiomyopathy s/p AICD/PPM, Barrett's esophagus, GERD, history of GIB and PUD for outpatient EGD.

The patient and her daughter gave their consent for photography/case report. She had bilateral mild wheezes which were improved after albuterol inhalation treatment. She had a Class II airway. An infant facemask was secured over her nose and connected to the anesthesia machine/circuit delivering 2-4 $cmH_2O$ CPAP (4L $O_2$/min). Her $SpO_2$ improved from 97% to 100%. Her oropharynx was treated with local anesthetic spray to reduce anesthetic requirement.

Deep sedation was titrated with lidocaine, etomidate, and propofol and maintained on propofol infusion (50 mcg/kg/min). Her mouth was covered with a clear plastic sheet (face tent) to reduce aerosol/droplet spread. She maintained spontaneous nasal CPAP ventilation and 100% $SpO_2$ throughout EGD without requiring any airway manipulation (Image). She tolerated the procedure well. She was awake/alert and was discharged home without any complications.

**Discussion**: This simple combined nasal mask-face tent maintained spontaneous CPAP ventilation/oxygenation in a frail elderly patient with severe cardiopulmonary diseases and OSA during EGD. It reduced aerosol/droplet spread during the procedure. Amidst the COVID-19 pandemic, it may improve both patient and provider safety at no extra cost.

**References**: 1. www.TSEmask.com; 2. SAMBA 28th AM, MCC, April 2013; 3. SASM MC's, Oct 2013; 4. ASA AM (MC536 & 1100), Oct 2013; 5. NYSSA 67th PGA (MCC 7094, 7115, 7120, 7129, 7189, 7199 & 7203) Dec 2013; 6. SAM AM MCC's, Sept 2014; 7. ASA AM: (MC1280), 2020; 8. NYSSA 74th PGA:MCC201, 2020



The nasal mask-face tent maintained spontaneous CPAP ventilation and reduced aerosol/droplet spread.