From Idea to Publication: An Overview of Respiratory Care Research

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Learning Objectives

1. Discuss the importance of sharing of respiratory care research
2. Describe how to turn common respiratory care department projects that can be published
3. Cover the importance of having a process for respiratory care research

About the Presenter

- Associate Director of Respiratory Care Research for Pediatric Critical Care Medicine
- RT/ECMO Specialist at Duke University Medical Center
- Member of BOD for CVCSCCM
  - Member of Research Committee
- Chair of Respiratory Care Department research committee
- Co-chair of SCCM Respiratory Care Section Research Committee
- Section Editor for RESPIRATORY CARE

Duke Children's

Conflicts of Interest & Disclosures

- Section Editor for RESPIRATORY CARE
- Have received honorarium from Saxe Communications for webinars

- Any products shown are used as examples and are not an endorsement
- Figures are cited where applicable or used under Fair Use

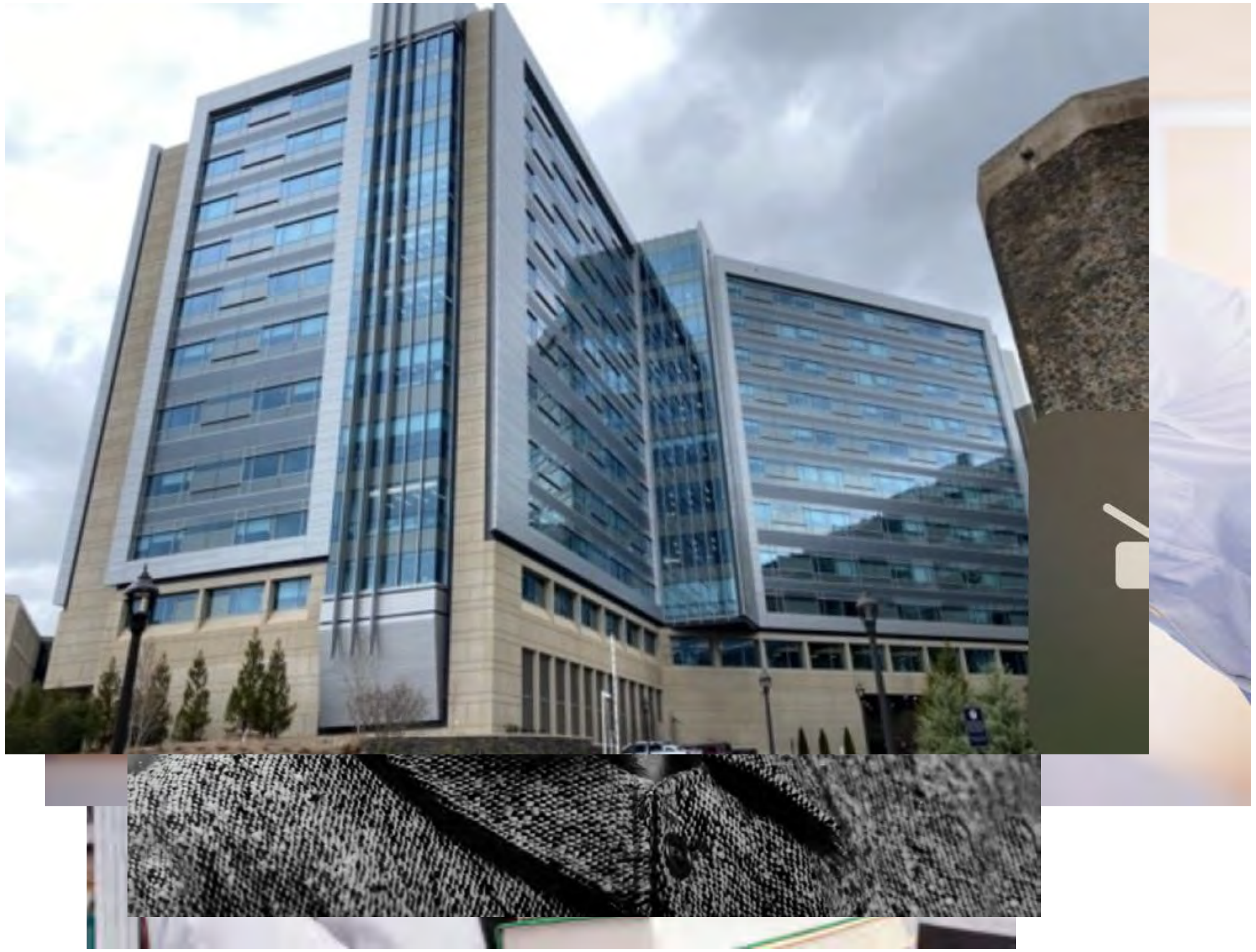
Why Research Important

To improve patient outcomes

- Compare strategies used in clinical practice
- Demonstrate the impact of quality improvement projects
- Investigate how technology functions
- Increase understanding of physiology of different disease states
- Identify biologic mechanisms for targeted interventions

Who We Think Does Research

- Nerds
- Geeks
- Geniuses
- Large, well funded groups



Who Actually Does Research

- Everyone!
- Every day items
  - Cell phone plan
  - Washer/drier
  - Where to work
- At work
  - Literature search
  - QI/QA processes
  - Clinical observations

Examples of RT Led Research

- Clinical trials
- Before & after studies
- Observational studies
  - Prospective
  - Retrospective
- Quality improvement
- Surveys
- Bench studies

Performance Evaluation of Nasal Prong Interface for CPAP Delivery on a Critical Care Ventilator: A Bench Experiment

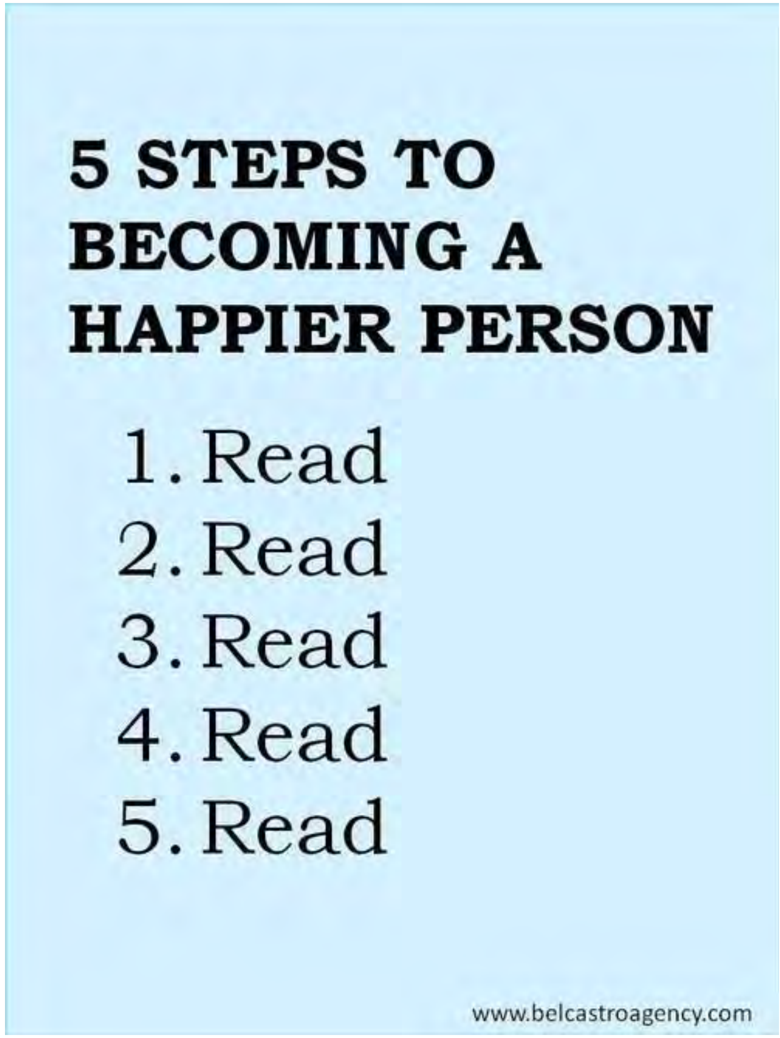
Natalie Napolitano, Tracey Roberts, Amanda J Nickel, Joseph McDonough, Haorui Sun, Rui Feng, Erik A Jensen, Kevin Dysart, and Richard Lin

Key to Success - Skill Development

- Research is a skill that can be developed
- Made of individual skills
  - Reading
  - Writing
  - Database management
  - Data collection & security
  - Statistical analysis
  - Team dynamics
  - Leadership
  - IRB
  - Navigating peer review

Read! Read! Read!

- Read as many papers as you can
- RESPIRATORY CARE is a good starting point
- Other journals
  - NEJM
  - Lancet
  - JAMA
  - Critical Care Medicine
  - Blue Journal (American Journal of Respiratory and Critical Care Medicine)
  - Critical Care
  - Chest
  - Pediatrics



Where to Start

- Start small
- Ask a clinically question
  - Something controversial/unknown
- Find a mentor
- Do a literature search
  - Find what has been published
  - See what you can add
  - Discussion section is a great source
- Design your study
  - Retrospective review or bench study are good first projects

Picking a Project

Do!

- Pick something you care about
- Consider confirming a prior study
- Address a clinical problem at your center
- Use existing QA or QI data
- Chance to grow your skills

Don't!

- Pick a "hot topic"
  - Burnout, COVID-19
- Overreach
  - Avoid large, complex studies
- Go it alone!
- Find a mentor, build a team

First Step – Literature Search

- Identify the research question!
- First step is always a literature review
- PubMed is a great source
  - Seek out similar papers to your project
  - Get full-text versions of all papers
  - Library and librarians are your friend!
  - Drill down on the methodology used
- Make an annotated bibliography
- Keep all the papers in the same location

Find a Mentor

- Someone who has experience
- Physician, RT, or another
- Ideally within your institution
- RESPIRATORY CARE staff have offered to mentor RT researchers
- Help guide you in the right direction
- Schedule regular meetings
- Be careful, the wrong mentor can lead you down the wrong path

Next Step

- Summarize what is known in a formal document
  - Example to the right
- Present and discuss with your mentor
- Establish a plan for your study
- Assess feasibility

Background: Pediatric patients are frequently placed on high-frequency ventilation due inadequate adequate gas exchange, secretion clearance, air leak, pulmonary interstitial emphysema, or inability to maintain lung-protective conventional ventilator settings. High-frequency jet ventilation (HFJV) is used predominantly in premature neonates; however high-quality, high-level data supporting its use are lacking.[1,2] The role, if any, of HFJV in premature neonates is still unclear.[3]

There are a paucity of data evaluating HFJV in non-neonatal pediatric patients. Most data are single center case series who enrolled small numbers of patients or are outdated.[4-8] Zhang et al described a series of 25 infants (mean weight 2.8 kg) with congenital diaphragmatic hernia who were managed with HFJV. HFJV was associated with minimal complications and resulted in a significant increase in pH and decrease in PaCO2. Their mortality rate was 64% in this series. Valentine et al. described the use of HFJV in a series of 11 infants and children (1.7 to 14.2 kg, aged 2 to 156 weeks) with respiratory syncytial virus. They observed increased pH and decreased $PaCO_2$. Their survival to discharge was 91% (10/11). We would like to describe the use of HFJV in non-neonatal pediatric patients managed in the Pediatric Intensive Care Unit (PICU) and Pediatric Cardiac Intensive Care Unit (PCICU).

Research Question: What is the effectiveness of high-frequency jet ventilation (HFJV) in pediatric patients?

Designing Your Study

- Clearly state your hypothesis
- Establish primary and secondary outcomes
    - Selected based on study design and sample size
- Subject identification
- Inclusion/exclusion criteria

Hypothesis: We hypothesize that HFJV is safe and results in improvement in gas exchange.

Primary Outcome: Improvement in blood gas values.

Secondary Outcome(s): Need for ECMO, escalation to other high-frequency modes, mortality, time on mechanical ventilation, ICU length of stay.

Method: Retrospective chart review of all patients who received HFJV at Duke Children's hospital in the PICU and PCICU between June 2013 and October 2018. If able to identify pre-Maestro care patients, will consider their inclusion. Would consider sample size > 60 subjects to be sufficient.

Subject Identification: Performance services will identify the patients through a search of the electronic medical record.

Inclusion criteria: All patients > 1 month of age receiving HFJV in the PICU or PCICU.

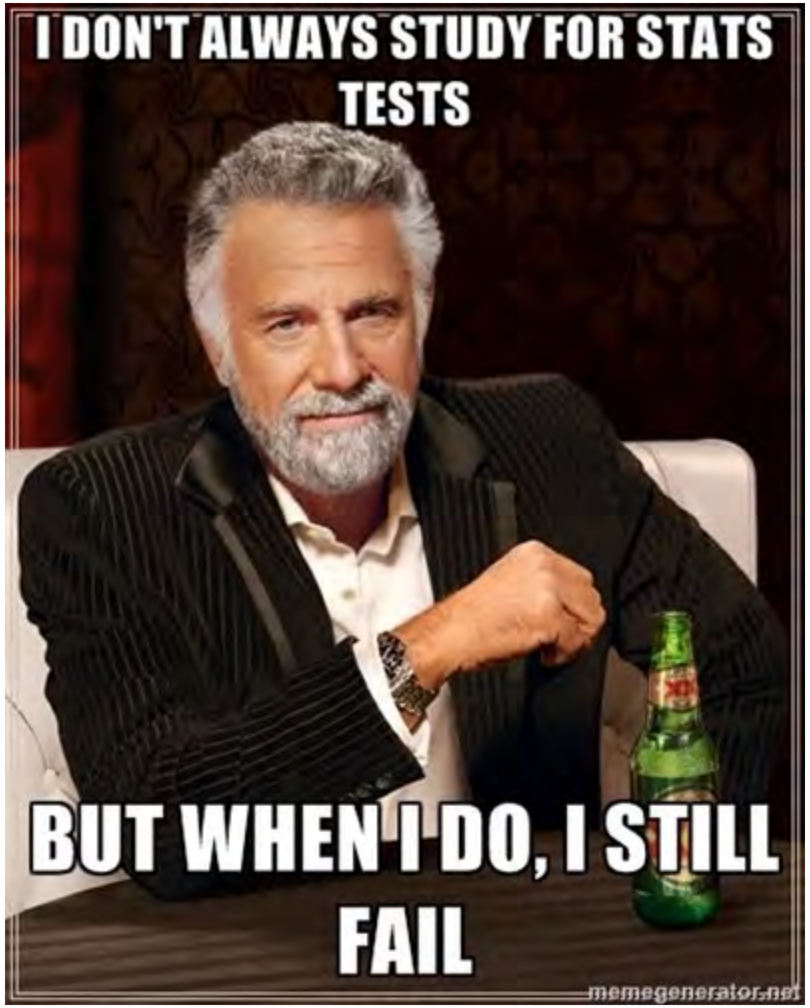
Exclusion criteria: HFJV initiated during ECMO. Premature infants who have not been discharged home following birth.

Designing Your Study – Data Collection

- Part that takes the most time
- Use secure database
  - REDCap, Microsoft Forms
  - Avoid Excel
  - Must meet IRB requirements
- Prepare for unexpected barriers
  - Smaller numbers than expected
  - Data collection taking longer than expected
  - Unable to access some data
  - Problems with technology

Statistics

- Learn the basics
  - What tests to use
  - How to describe data
  - How to interpret the results
- Have a clear plan
  - Don’t change once you’ve started
  - If added analysis, note clearly in methods
- Find an expert ☺
  - Someone with formal training
  - Grad school doesn’t qualify
- Don’t let lack of stats knowledge derail you
  - People want to help!



Institutional Review Board

- IRB protects research subjects
  - CITI training
- Any study involving patient data will require IRB approval
- QI and survey projects are exempt
  - IRB makes that decision
- Different types of review
  - Expedited
  - Full board review
- Minimal risk studies or retrospective studies can get a waiver of consent

Reporting the Results

- Journals have a specific format
  - Introduction
  - Methods
  - Results
  - Discussion
  - Conclusion
- Abstracts are similar
  - No discussion section

Interpreting the Results

- Results are presented in tables and figures
- Depending on the study
  - Flow diagram
  - Table 1 with subject demographics
  - Table 2 with primary and secondary outcomes
  - Figures to describe outcomes
  - Additional tables and figures for multivariable analysis
  - Large studies often have large amounts of supplemental material

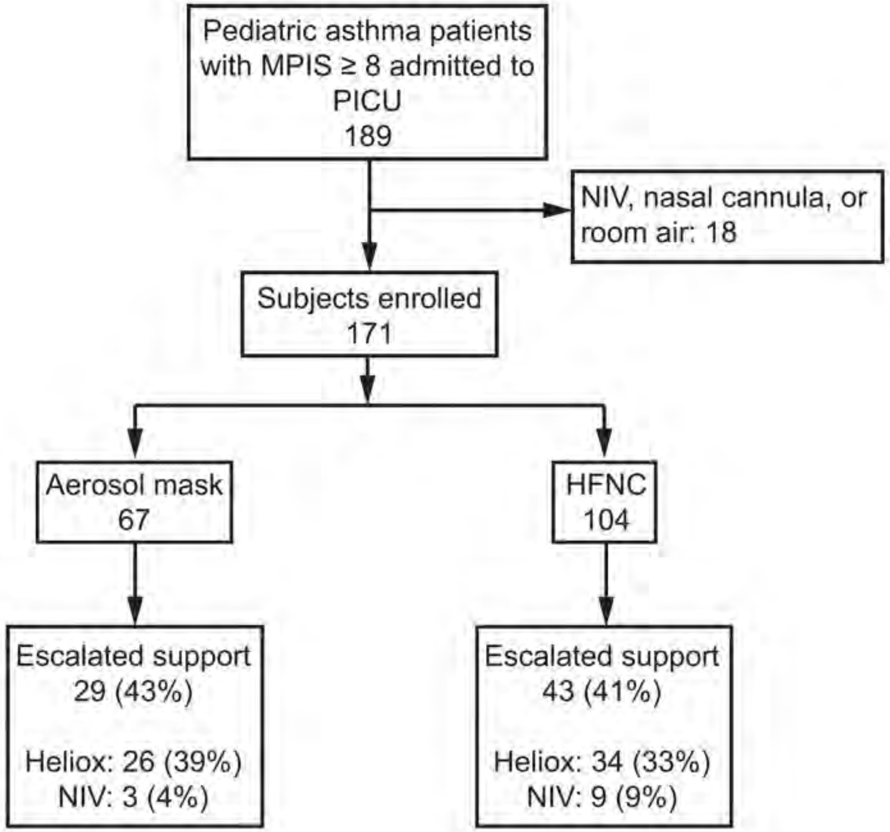


Fig. 1. Flow chart. MPIS = modified pulmonary index score; PICU = pediatric ICU; NIV = noninvasive ventilation; HFNC = high-flow nasal cannula; heliox = helium-oxygen mixture.

Table 1

- Decide what should be in the table
    - Rest can be in the text
    - Don't repeat in both
- Primary characteristics of the subject population
- Does not include outcomes

Table 1. Subject Characteristics

Table 1. Subject Demographics

	Aerosol Mask ($n = 67$)	HFNC ($n = 104$)	P
Age, y	7 (5–10)	5 (4–9)	.006
Female	29 (43)	53 (51)	.33
Weight, kg	29.8 ± 15.5	26.6 ± 15.6	.19
Home medications			
Short-acting β_2 agonist	55 (82)	89 (86)	.54
Inhaled corticosteroid	34 (51)	41 (39)	.15
Long-acting β_2 agonist + inhaled corticosteroid	9 (13)	16 (15)	.72
None	12 (18)	12 (12)	.24
History			
Intubation	3 (4)	3 (3)	.58
ICU admission	22 (33)	32 (31)	.78
Noninvasive ventilation	2 (3)	1 (1)	.33
None	44 (66)	71 (68)	.72
Cause of exacerbation			.41
Viral	46 (69)	63 (61)	
Unknown/unreported	1 (1)	5 (5)	
Environmental	2 (3)	9 (9)	
Nonadherence	4 (6)	6 (6)	
Exposure	1 (1)	5 (5)	
Route of admission			.71
Emergency department	30 (45)	39 (38)	
Hospital wards	8 (12)	11 (11)	
Outside hospital	27 (40)	47 (45)	
Stepdown	1 (1)	5 (5)	
Admission data			
Heart rate, beats/min	155 ± 14	158 ± 16	.24
Breathing frequency, breaths/min	37 ± 0.5	37 ± 0.4	.36
F_{IO_2}	0.50 ± 0.29	0.45 ± 0.28	.38
S_{pO_2}	96 ± 3	95 ± 3	.68
Admission MPIS	10 (9–12)	11 (9–12)	.15
MPIS 8–9	29 (43)	31 (30)	.16
MPIS 10–11	17 (25)	38 (37)	
MPIS ≥ 12	21 (31)	35 (34)	

Data are presented as n (%), mean ± SD, or median (interquartile range).
MPIS = modified pulmonary index score

HFJV = high-frequency jet ventilation

Table 2

- Includes primary and secondary outcomes
- Most important part
- Can be supplemented by figures
- Some data are better presented visually

Table 2. Subject Outcomes

	Aerosol Mask	HFNC

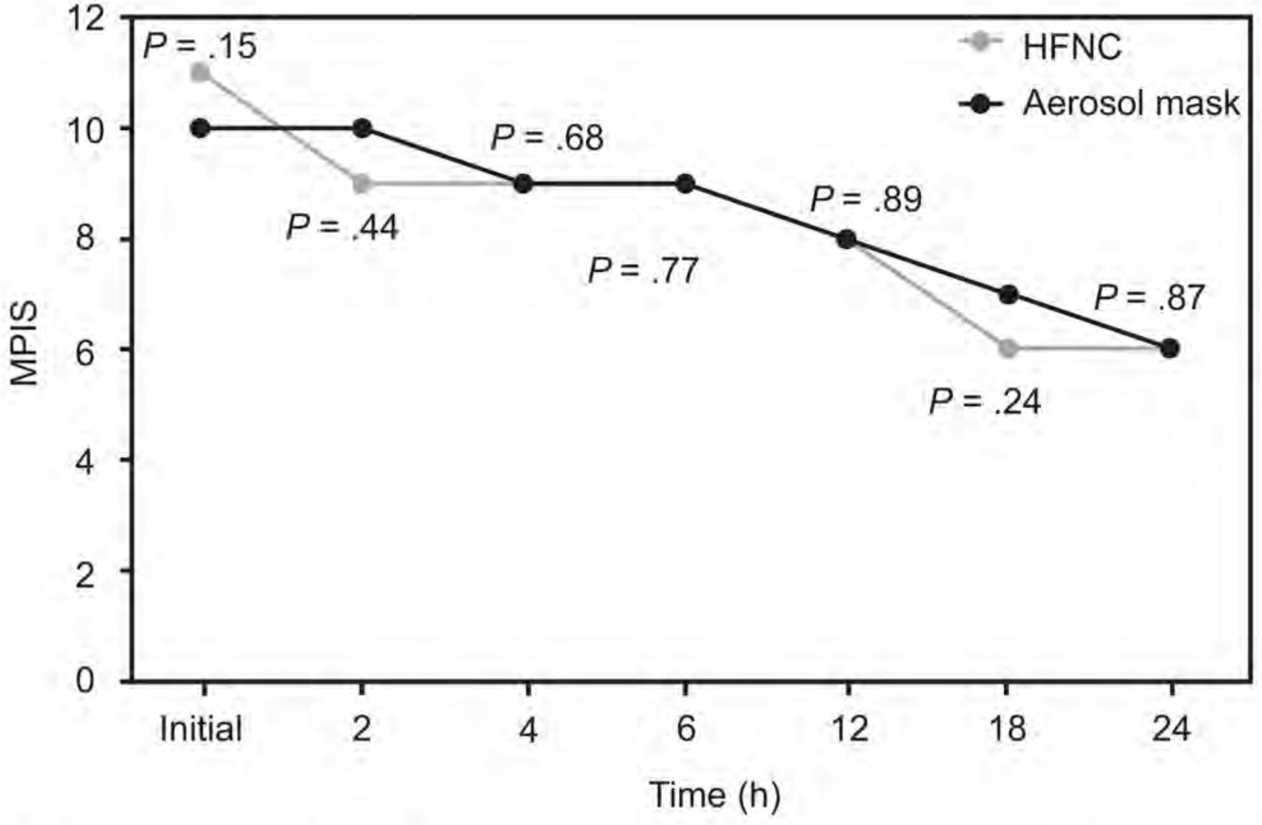


Fig. 2. Progression of modified pulmonary index score (MPIS) over time. HFNC = high-flow nasal cannula.

Additional Tables

- Additional tables are for secondary outcomes and multivariable analysis
- Can add many more tables
  - Some journals limit the number
  - RESPIRATORY CARE has no limit
- Some may be better suited to supplemental files

Table 4. Comparison of Survivors vs. Non-Survivors

Variable	*n*	Survivors	*n*	Non-Survivors	*P*
Subjects, *n* (%)		26 (74)		9 (26)	
Demographics					
Age, months	26	2.7 (1.7–7.6)	9	6.8 (0.4–10.1)	.87
Weight, kg	26	5.2 (3.8–6.8)	9	5.2 (3.4–8.7)	.93
PIM2, %	26	1.6 (0.5–4.1)	9	6.3 (2.6–26.5)	.01
Documented infection, Y (%)	26	22 (85%)	9	4 (44%)	.02
Documented infection					
Bacterial	26	2 (8%)	9	2 (22%)	.02
None	26	4 (15%)	9	5 (56%)	
Viral	26	20 (77%)	9	2 (22%)	
Calculated gas exchange variables					
Pre-HFJV OI	21	11.3 (7.5–16.9)	6	13.1 (6.5–15.9)	.11
Pre-HFJV P/F	21	134.0 (71.5–198.8)	6	123.9 (97.8–205.5)	.93
Ventilatory index	20	46.9 (34.0–55.2)	7	60.8 (39.3–70.2)	.31
Arterial blood gas					
pH	23	7.22 (7.14–7.30)	8	7.13 (7.02–7.22)	.054
P_{aCO_2}, mmHg	23	64 (53–83)	7	68 (46–94)	> .99
P_{aO_2}, mmHg	23	72 (59–109)	7	86 (72–126)	.47
HCO_3^-, mEq/L	23	27 (23–32)	7	18 (13–31)	.054
Base excess/deficit, mmol/L	23	−1 (−5–4)	7	−10 (−12–1)	.061
OI 4–6 h post HFJV	19	10 (8.1–16.7)	5	9.9 (6.6–29.8)	.73
P/F 4–6 h post HFJV	19	118.6 (78.6–164)	6	93.1 (33.8–246.2)	.56

Continuous variables presented as median (IQR); categorical variables presented as *n* (%). HCO_3^-, bicarbonate; HFJV, high-frequency jet ventilation; OI, oxygenation index; P/F, PaO_2:FIO_2 ratio; P_{aO_2}, partial pressure of arterial carbon dioxide; P_{aO_2}, partial pressure of arterial oxygen; PIM2, Pediatric Index of Mortality.

Writing the Abstract

- Refer back to your proposal
- Background should be straightforward
  - State your hypothesis or objective
- Methods should be clear and detailed
  - Make sure IRB approval is noted
- Results can be challenging to decide what to include
  - Primary and secondary outcomes should be included

BACKGROUND: High-frequency jet ventilation (HFJV) is primarily used in premature neonates; however, its use in pediatric patients with acute respiratory failure has been reported. The objective of this study was to evaluate HFJV use in the pediatric critical care setting. We hypothesized that HFJV would be associated with improvements in oxygenation and ventilation. **METHODS:** Medical records of all patients who received HFJV in the pediatric ICU of a quaternary care center between 2014 and 2018 were retrospectively reviewed. Premature infants who had not been discharged home were excluded, as were those in whom HFJV was started while on extracorporeal membrane oxygenation. Data on demographics, pulmonary mechanics, gas exchange, and outcomes were extracted and analyzed using chi-square testing for categorical variables, nonparametric testing for continuous variables, and a linear effects model to evaluate gas exchange over time. **RESULTS:** A total of 35 subjects (median age = 2.9 months, median weight = 5.2 kg) were included. Prior to HFJV initiation, median (interquartile range) oxygenation index (OI) was 11.3 (7.2–16.9), P_{aO_2}/F_{IO_2} = 133 (91.3–190.0), pH = 7.18 (7.11–7.27), P_{aCO_2} = 64 (52–87) mm Hg, and P_{aO_2} = 74 (64–125) mm Hg. For subjects still on HFJV (n = 25), there was no significant change in OI, P_{aO_2}/F_{IO_2}, or P_{aO_2} at 4–6 h after initiation, whereas pH increased (P = .001) and P_{aCO_2} decreased (P = .001). For those remaining on HFJV for > 72 h (n = 12), the linear effects model revealed no differences over 72 h for OI, P_{aO_2}/F_{IO_2}, P_{aCO_2}, or mean airway pressure, but there was a decrease in F_{IO_2} while pH and P_{aO_2} increased. There were 9 (26%) subjects who did not survive, and nonsurvivors had higher Pediatric Index of Mortality 2 scores (P = .01), were more likely to be immunocompromised (P = .01), were less likely to have a documented infection (P = .02), and had lower airway resistance (P = .02). **CONCLUSIONS:** HFJV was associated with improved ventilation among subjects able to remain on HFJV but had no significant effect on oxygenation. *Key words: pediatric respiratory failure; high-frequency ventilation; jet ventilation; gas exchange; pediatric ARDS; mechanical ventilation; children; oxygenation; ventilation.* [Respir Care 2021;66(2):191–198. © 2021 Daedalus Enterprises]

Background

- 3-5 sentences describing your study

Background: ~~The use of continuous albuterol has been shown to a be safe and effective treatment for severe asthma exacerbations.~~ Current asthma guidelines recommend patients with mild to moderate asthma exacerbation be treated with three 2.5-5 mg albuterol treatments with 0.5 mg atrovent within 1 hour of their arrival and to assess for response. For severe exacerbations, continuous albuterol therapy may be indicated. ~~A literature review showed that the patients with the most severe airflow obstruction may benefit from the use of continuous albuterol. There is currently no data showing toxicity with continuous albuterol administration.~~ The purpose of this review was to examine our current emergency department continuous albuterol practice. Methods: Pediatric patients placed on

Methods

METHODS: We retrospectively reviewed the medical records of children with critical asthma (age 2–17 y) with a modified pulmonary index score (MPIS) ≥ 8 admitted to our pediatric ICU as part of a quality improvement project. Patients were managed with our MPIS-based, respiratory therapist-driven protocol. Subjects were divided into 2 cohorts by initial respiratory support: HFNC or aerosol mask. Data included demographics, initial respiratory support, and MPIS over time. Primary outcome was hospital length of stay (LOS). Secondary outcome was difference in MPIS over time.

Methods

Methods: RCPs certified in arterial line insertion were trained in radial artery catheterization using ultrasound by Emergency Medicine physicians. After obtaining IRB approval for this study, patients were enrolled based on the need for an arterial line placement. ~~The catheters used were Sharps Radial Artery Catherization Set with a 20 gauge catheter, 22 gauge introducer wire, and spring wire guide with integral needle protection. The ultrasound devices were the Sonosite iLook and the Sonosite MicroMaxx.~~ Data recorded included strength of pulse, systolic and diastolic blood pressure, number of attempts (3 or less punctures per attempt), successful/unsuccessful artery cannulation. ~~Catheterizations were performed according to institutional policy and procedure.~~

Results

RESULTS: A total of 35 subjects (median age = 2.9 months, median weight = 5.2 kg) were included. Prior to HFJV initiation, median (interquartile range) oxygenation index (OI) was 11.3 (7.2–16.9), P_{aO_2}/F_{IO_2} = 133 (91.3–190.0), pH = 7.18 (7.11–7.27), P_{aCO_2} = 64 (52–87) mm Hg, and P_{aO_2} = 74 (64–125) mm Hg. For subjects still on HFJV (*n* = 25), there was no significant change in OI, P_{aO_2}/F_{IO_2}, or P_{aO_2} at 4–6 h after initiation, whereas pH increased (*P* = .001) and P_{aCO_2} decreased (*P* = .001). For those remaining on HFJV for > 72 h (*n* = 12), the linear effects model revealed no differences over 72 h for OI, P_{aO_2}/F_{IO_2}, P_{aCO_2}, or mean airway pressure, but there was a decrease in F_{IO_2} while pH and P_{aO_2} increased. There were 9 (26%) subjects who did not survive, and nonsurvivors had higher Pediatric Index of Mortality 2 scores (*P* = .01), were more likely to be immunocompromised (*P* = .01), were less likely to have a documented infection (*P* = .02), and had lower airway resistance (*P* = .02).

Results: 135 pediatric patients who required bronchodilation therapy in the emergency department were included. 121 (89.6%) patients were admitted and 131 (97%) of patients received corticosteroids. Overall 128 (94.8%) were diagnosed as having reactive airway disease or asthma, 2 (1.5%) with cystic fibrosis, 2 (1.5%) with allergic reactions, and 3 (2.2%) with other diagnoses. 58 patients received 0 bronchodilator treatments prior to initiation of continuous albuterol, 52 patients received 1 or 2 bronchodilator treatments, and 25 patients received 3 or more treatments prior to initiation of continuous albuterol.

No p-values
No comparison of disease severity or vital signs

# of Treatments Prior to Continuous Albuterol

	0	1-2	3 or more
Admission Rate	53/58 (91.4%)	45/52 (86.5%)	23/25 (92%)
Corticosteroids	56/58 (96.6%)	50/52 (96.2%)	25/25 (100%)
Diagnosis			
Asthma/RAD	53/58 (91.4%)	51/52 (98.1%)	24/25 (96%)
Disposition			
PICU	23/58 (39.7%)	18/52 (34.6%)	6/25 (24%)
Stepdown	12/58 (20.7%)	11/52 (21.2%)	6/25 (24%)
Regular/CEU	18/58 (31%)	16/52 (30.8%)	11/25 (44%)

Conclusion

> Conclusion: In this group of patients immediate placement on continuous albuterol did not lower the overall admission rate. Patients receiving 3 bronchodilator treatments prior to initiation of continuous albuterol had lower rates of PICU admissions and higher rates of regular/CEU admission. Our results appear to support the existing guidelines.

- Examples: HFJV was associated with improved ventilation among subjects able to remain on HFJV but had no significant effect on oxygenation
- Example 2: HFNC performed similarly to aerosol mask in pediatric patients with critical asthma.

Editing

- Most abstracts will require multiple versions
- Usually around 5-10
- Constructive feedback is helpful
- Goal is to make the work as good as possible

Leverage Your Existing Data

- Departmental metrics
  - SBT compliance
  - Lung protective ventilation
  - Unplanned extubations, pressure injuries
  - Assignments/productivity
- Hospital/ICU metrics
  - Length of stay
  - Reintubation
  - Time on mechanical ventilation
  - Readmissions

Pitfalls to Avoid

- Decide what you want to find before you start
- Start before having a clear plan
- Present partial results
- Overstate your findings

Summary

- Research is a skill
- Find a mentor
- READ READ READ!
- Start small
- Don’t get discouraged

Thank You

- Questions?
- Email me at: Andrew.g.miller@duke.edu
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