

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. **DO NOT EXCEED FIVE PAGES.**

NAME: Geis, Gary L.

eRA COMMONS USER NAME (credential, e.g., agency login): GAGEIS

POSITION TITLE: Professor of Pediatrics, Division of Emergency Medicine; Medical Director, Center for Simulation and Research; Program Director, Medical Simulation Fellowship

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE (if applicable)	Completion Date MM/YYYY	FIELD OF STUDY
University of Cincinnati, College of Engineering, Cincinnati, OH	B.S.	06/1991	Civil and Environmental Engineering
University of Cincinnati, College of Medicine, Cincinnati, OH	M.D.	06/1997	Medicine
Children's Hospital of The King's Daughters, Norfolk, VA	Residency	06/2000	Pediatrics
Children's Hospital of The King's Daughters, Norfolk, VA	Chief Residency	06/2001	Pediatrics
Cincinnati Children's Hospital Medical Center, Cincinnati, OH	Fellowship	06/2004	Pediatric Emergency Medicine

A. Personal Statement

As a board-certified pediatrician (20 years) and board-certified pediatric emergency physician (17 years), I have accumulated a significant amount of clinical experience in the care of acutely injured and ill children. More specifically, I have pursued clinical expertise in the management of pediatric airways.

In the initial years after fellowship I attended multiple airway courses nationally, including the Difficult Airway Course™ and the Practical Emergency Airway Management Course. Additionally, I developed a quarterly rotation in the operating suites here for myself with a small group of anesthesiology attendings. In my third year as faculty, I developed and built the Medical Resuscitation Committee – an interprofessional group of physicians and nurses who took over education, training, quality improvement and research within our emergency department's shock trauma suites (STS). As part of our early work, I instituted a video-review process for resuscitation care, built a monthly medical video review conference and introduced in situ simulation to the shock trauma suites as part of an AHRQ-funded two-year grant to study in situ simulation. Early in program development I co-authored a paper on the frequency, or lack there, of invasive procedures performed by fellows and faculty within the STS. In response, I co-developed a standing airway rotation for all the emergency medicine faculty where they were scheduled into the operating suites twice a year to practice bag-mask ventilation, placement of supraglottic airways and endotracheal intubation. Additionally, I introduced video laryngoscopy into the STS initially using the GlideScope and then transitioning to the Storz C-MAC system.

I was one of our internal investigators who assessed medication-assisted intubations in the STS setting, then developed a quality improvement program to address our first time success rate and complication rate. I am proud to say that the combination of a rapid sequence intubation checklist, co-pilot model for use of the cognitive aid, and video laryngoscopy have improved our 1st-attempt success rate from 52% to almost 80%, reduced desaturation from 33% to less than 15% and almost eliminated esophageal intubations in our setting. Most recently, I have co-led a quality improvement project to eliminate cardiopulmonary arrest during endotracheal intubation. As part of a collaborative working group of emergency department and pediatric

intensive care unit providers, we developed six high-risk criteria that put pediatric patients at risk for cardiopulmonary arrest in the peri-intubation period. We have now published two papers, the first detailing the performance of these criteria in a retrospective review and the second detailing our development of the PICU-ED Team (PET). This novel care team/process identifies at risk patients, mobilizes critical care providers, recommends specific supportive care prior to intubation and provides a collaborative team-level discussion before intubation attempts. Since introduction of the PET we have not had a patient suffer cardiopulmonary arrest in the peri-intubation period in the STS.

Beyond my clinical role, I routinely educate medical students, pediatric and emergency medicine residents, and pediatric emergency fellows as a Professor of Pediatrics at the University of Cincinnati, College of Medicine. In addition to these standard teaching roles, I have been a Pediatric Advanced Life Support (PALS) instructor for 16 years, as well as an Advanced Cardiovascular Life Support (ACLS) and an Advanced Trauma Life Support (ATLS) instructor for 11 years. Eight years ago I became certified as a provider and master trainer for Helping Babies Breathe (HBB). I strongly feel that my status as an instructor in these Life Support courses allows me to be a better clinical, but also forces me to stay up on all of the literature surrounding resuscitative care. Annually, I am responsible for the PALS pages within our residency's handbook, known as "The Pocket." These pages include the PALS algorithms adapted for use in our institution, a page with resuscitation equipment and a page with resuscitative medications. Additionally, I author the PALS algorithms that are used in our STS and on the code carts throughout the institution which I update annually and thoroughly revise every five years based on AHA updates.

I have been actively involved in simulation-based training and research for over 20 years; served as the Assistant Medical Director at our Center for Simulation and Research (CSR) for four years; and have been the Medical Director since July 2011. Since 2004, I have worked within our institution to develop, implement and assess simulation-based training curriculum for physician and non-physician staff across lab, in situ and outreach settings. During the initial years, I leveraged simulation to improve teamwork and communication behaviors, and assessed clinical units for latent safety threats and team-level knowledge deficits. Over the last 10 years, while continuing work on team training and systems integration, I have developed and implemented multiple simulation-based training programs surrounding procedural skill training, team leadership, recognition of sepsis and medical decision making. I have built a three-room lab focused on procedural skills, including an airway lab that allows deliberate practice of bag-mask ventilation, supraglottic airways, orotracheal intubation, nasotracheal intubation, and fiberoptic intubation. Additionally, I have personally built training to allow for practice in managing airways complicated by tonsillar hemorrhage, airway hemorrhage and foreign body airway obstruction, including training on needle and surgical cricothyrotomy. I currently directly oversee the development, medical content, delivery and facilitation of 110-plus courses annually at the CSR.

Relevant to this proposal, over the last decade I have worked within the institution to identify and support expertise within technology-based immersive training platforms. This included both recruiting and retaining the high-level application development team we have within the CSR, while pairing them with talented educational researchers such as Dr. Zackoff. Our Center not only employs these developers, but we have dedicated an education specialist to help implement their novel platforms within our clinical workforce. Most specific to this proposal, I have mentored faculty and fellows within Emergency Medicine, Critical Care, Anesthesiology and Neonatology through funded studies focused on procedural training, including bag-mask ventilation, endotracheal intubation, placement of supraglottic devices, and placement of intraosseous catheters. In the last year alone, I have mentored an emergency medicine fellow on the use of virtual reality and artificial intelligence for training residents to perform and verbalize their circulatory assessment on critically ill patients and a medical simulation fellow on the use of virtual reality for training staff physicians and advanced practice providers to perform digital blocks for local anesthesia. Dr. Zackoff was part of our study team for both projects demonstrating our high-level of active and productive collaboration.

In summary, this accrued level of clinical, educational, research and administrative expertise allows me to serve as a co-investigator for this current proposal, "Maintaining and Enhancing Advanced Skills Through Experiential and Realistic Virtual Reality: An Efficacy and Validation Study of iMASTER-VR."

B. Positions, Scientific Appointments, and Honors

Positions:

- | | |
|--------------|---|
| 2019-present | Professor of Pediatrics, Division of Emergency Medicine, Cincinnati Children's Hospital Medical Center, University of Cincinnati, College of Medicine, Cincinnati, OH |
| 2010-2019 | Associate Professor of Pediatrics, Division of Emergency Medicine, Cincinnati Children's |

2004-2010 Hospital Medical Center, University of Cincinnati, College of Medicine, Cincinnati, OH
 Assistant Professor of Pediatrics, Division of Emergency Medicine, Cincinnati Children's
 Hospital Medical Center, University of Cincinnati, College of Medicine, Cincinnati, OH
 2000-2001 Instructor of Pediatrics, Division of Emergency Medicine, Children's Hospital of The King's
 Daughters, Eastern Virginia Medical School, Norfolk, VA

Honors:

1998 Intern of the Year, Children's Hospital of The King's Daughters, Norfolk, VA
 2000 Senior Resident of the Year, Children's Hospital of The King's Daughters, Norfolk, VA
 2004 Fellow Teaching Award, Department of Pediatrics, Cincinnati Children's Hospital Medical
 Center, Cincinnati, OH
 2005 Golden Apple (Teaching) Award, Department of Emergency Medicine, University of Cincinnati,
 College of Medicine, Cincinnati, OH
 2006 Faculty Teaching Award, Department of Pediatrics, Cincinnati Children's Hospital Medical
 Center, Cincinnati, OH
 2006 Golden Apple (Teaching) Award, Department of Emergency Medicine, University of Cincinnati
 College of Medicine, Cincinnati, OH
 2007 Golden Apple (Teaching) Award, Department of Emergency Medicine, University of Cincinnati
 College of Medicine, Cincinnati, OH
 2008 Golden Apple (Teaching) Award, Department of Family Practice, University of Cincinnati
 College of Medicine and The Christ Hospital, Cincinnati, OH
 2011 Golden Apple (Teaching) Award, Department of Emergency Medicine, University of Cincinnati
 College of Medicine, Cincinnati, OH
 2015 Educational Achievement Award, Department of Pediatrics, Cincinnati Children's Hospital
 Medical Center, Cincinnati, OH
 2017 Named an "All Star" attending physician by the graduating class of residents from 2007 as part
 of their 10-year reunion at Cincinnati Children's Hospital Medical Center
 2019 Named one of the top reviewers for Simulation in Healthcare: Journal of the Society for
 Simulation in Healthcare®. Honored at the January 2020 IMSH in San Diego.

Memberships in Professional Organizations, Licensing and Certifications:

1997-present American Academy of Pediatrics
 2001-present State of Ohio Medical License
 2001-present Specialty Board Certification: General Pediatrics, American Board of Pediatrics
 2004-present Subspecialty Board Certification: Pediatric Emergency Medicine, American Board of
 Pediatrics
 2008-present Society for Simulation in Healthcare

C. Contributions to Science

One area of scientific focus/contribution has been pediatric airway management. This area of interest grew out of my clinical practice in the emergency department, where airway emergencies and procedural intervention are the most frequent and high-risk situation we face. Although common in adult emergency departments, the need for emergent intubation is relatively uncommon in the pediatric ED setting. A working group (Medical Resuscitation Committee) that I developed and continue to mentor has made significant strides identifying the frequency and complications of intubations in the pediatric ED setting, implementing quality improvement interventions surrounding rapid sequence intubation, and measuring effect of those interventions. Publications most specific to this area include:

Kerrey BT, Rinderknecht AS, **Geis GL**, Nigrovic LE, Mittiga MR. Rapid Sequence Intubation for Pediatric Emergency Patients: Higher Frequency of Failed Attempts and Adverse Effects Found by Video Review. *Ann Emerg Med*. 2012 Sept;60(3):251-9. PMID: 22424653

Rinderknecht AS, Mittiga MR, Meinen-Derr J, **Geis GL**, Kerrey BT. Factors associated with oxyhemoglobin desaturation during rapid sequence intubation in a pediatric emergency department: findings from multivariable analyses of video review data. *Acad Emerg Med*. 2015 Apr;22(4):431-40. PMID: 25779855

Kerrey BT, Mittiga MR, Rinderknecht AS, Varadarajan KR, Dyas JR, **Geis GL**, Luria JW, Frey ME, Jablonski TE, Iyer SB. Reducing the incidence of oxyhaemoglobin desaturation during rapid sequence intubation in a paediatric emergency department. *BMJ Qual Saf*. 2015 Nov;24(11):709-17. PMID: 26183713

Kerrey BT, Mittiga MR, Boyd S, Frey M, **Geis GL**, Rinderknecht AS, Ahaus K, Varadarajan KR, Luria JW, Iyer SB. Sustained Improvement in the Performance of Rapid Sequence Intubation Five Years after a Quality Improvement Initiative. *Pediatr Qual Saf*. 2021 March/April; 6 (2);e385 (PMID pending).

A second area of scientific focus/contribution has been team-based training of healthcare providers using medical simulation to improve communication within teams, increase teamwork behaviors, identify and mitigate latent threats, and ultimately reduce serious safety events in the clinical setting. This area of interest grew out of my interest in pediatric resuscitation and my exposure to team-based care in our resuscitation bays. Serious safety or sentinel events have been described in the healthcare and risk management literature as frequently due to errors in communication and teamwork. Our simulation center, which I currently direct, has been on the cutting edge in leveraging medical simulation to improve safety within our institution since 2005. Publications most specific to this area include:

Geis GL, Pio BL, Pendergrass TL, Moyer MR, Patterson MD. Simulation to Assess the Safety of New Healthcare Teams and New Facilities. *Simul Healthc*. 2011 Jun; 6(3):125-133. PMID 21383646

Patterson MD, **Geis GL**, Lemaster T, Wears RL. Impact of multidisciplinary simulation-based training on patient safety in a paediatric emergency department. *BMJ Qual Saf*. 2013 May;22(5):383-93. PMID: 23258388

Couto TB, Kerrey BT, Taylor RG, FitzGerald M, **Geis GL**. Teamwork skills in actual, in situ, and in-center pediatric emergencies: performance levels across settings and perceptions of comparative educational impact. *Simul Healthc*. 2015 Apr;10(2):76-84.

Geis GL, Wheeler DS, Bunger A, Militello LG, Taylor RG, Bauer JP, Byczkowski TL, Kerrey BT, Patterson MD. A Validation Argument for a Simulation-Based Training Course Centered on Assessment, Recognition, and Early Management of Pediatric Sepsis. *Simul Healthc*. 2018;13(1):16-26. PMID: 29346221

A third area of scientific focus/contribution has been the development of new care processes within our shock trauma suites. I have partnered my clinical and simulation interests to (a) identify areas of need within our shock trauma suites, (b) use in situ simulation to best understand opportunities and develop solutions for improvement and (c) leverage simulation to implement and maintain developed processes. Publications most specific to this area include:

Johnson K, **Geis G**, Oehler J, Meinen-Derr J, Bauer J, Myer c, Kerrey B. Simulation to implement a novel system of care for pediatric critical airway obstruction. *Arch Otolaryngol Head Neck Surg*. 2012 Oct 1;138(10):907-11. PMID: 23069820

Hoehn EF, Cabrera-Thurman MK, Oehler J, Vukovic A, Frey M, Helton M, **Geis G**, Kerrey B. Enhancing CPR During Transition from Prehospital to Emergency Department: A QI Initiative. *Pediatrics*. May 2020;145(5) e20192908. Epub 2020 Apr 16. PMID: 32299822

Dean PN, Hoehn EF, **Geis GL**, Frey ME, Cabrera-Thurman MK, Kerrey BT, Zhang Y, Stalets EL, Zackoff MW, Maxwell AR, Pham TM, Lautz AJ. Identification of the Physiologically Difficult Airway in the Pediatric Emergency Department. *Acad Emerg Med*. 2020 Dec;27(12):1241-1248. PMID: 32896033

A fourth area of scientific focus/contribution has been the use of technology-based simulation, including motion capture, virtual reality and augmented reality. While these technology-based assessment and training strategies provide a wide amount of opportunities, I have been able to focus my collaborative work to resuscitative care for pediatric-aged patients. Publications most specific to this area include:

Kerrey BT, Boyd S, **Geis G**, Macpherson R, Cooper E, Kiefer A. Developing a Profile of Procedural

Expertise - a Simulation Study of Tracheal Intubation using 3D Motion Capture. *Simul Healthc.* 2020 Aug;15(4):251-258. PMID: 32168289

Zackoff MW, Cruse B, Sahay RD, Fei L, Saupe J, Schwartz J, Klein M, **Geis GL**, Tegtmeyer K. Development and Implementation of Augmented Reality Enhanced High-Fidelity Simulation for Recognition of Patient Decompensation. *Simul Healthc.* 2020 Sep 8. [Online ahead of print] PMID: 32910102

Complete List of Published Work in My Bibliography:
<http://www.ncbi.nlm.nih.gov/pubmed/?term=geis+gary>

BIOGRAPHICAL SKETCH

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Follow this format for each person. **DO NOT EXCEED FIVE PAGES.**

NAME: Kerrey, Benjamin T.

eRA COMMONS USER NAME (credential, e.g., agency login): BKERREY

POSITION TITLE: Professor of Pediatrics

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE (if applicable)	Completion Date MM/YYYY	FIELD OF STUDY
Creighton University, Omaha, NE	BS	05/1997	Mathematics
University of Nebraska, Omaha, NE	MD	06/2002	
Cincinnati Children's Hospital, Cincinnati, OH		06/2005	Residency, Pediatrics
Cincinnati Children's Hospital, Cincinnati, OH		06/2008	Fellowship, Pediatric Emergency Medicine
University of Cincinnati, Cincinnati, OH	MS	12/2011	Clinical & Translational Research

A. Personal Statement

I have the necessary expertise, leadership experience, and motivation to support completion of Dr. Zackoff's proposed research. **Expertise:** Over the last decade, I have developed expertise in several areas essential to successful completion of the proposed study, including simulation-based research of resuscitative care. I have lead and participated in numerous successful simulation-based investigations of resuscitative care, with a focus on emergency airway management. My previous airway and simulation-based research spans the full spectrum of investigation, from knowledge generation to clinical translation and quality improvement. I am currently leading teams at Cincinnati Children's working to improve rapid sequence intubation, management of high risk airways, and CPR quality and patient survival. We have received extramural and intramural funding for numerous airway-related research projects, including several that are directly relevant to Dr. Zackoff's proposal. **Leadership:** From 2007-09, I served as the site principal investigator for a multicenter study through the Pediatric Emergency Care Applied Research Network, the aim of which was to identify low-risk criteria for serious intra-abdominal injury in children after blunt trauma. Our enrollment percentage and protocol adherence was the highest among 20 participating centers, and I gained invaluable experience with successful participation in a multicenter study. In 2012 I became the Research Director for the Center for Simulation and Research at Cincinnati Children's, a nationally-recognized leader in simulation-based research. In this position, I gained experience designing and leading successful grant-funded research. Since 2018 I have been the director of the Medical Resuscitation Committee in the Division of Emergency Medicine at Cincinnati Children's. This committee has gained national recognition for its highly refined process of video-based peer review and quality assurance activities, clinical research, development of cognitive aids, and in situ simulation program. I am also a co-founder of the Videography In Pediatric Emergency Research collaborative, through which I have gained expertise in multicenter resuscitation research. **Motivation:** I am highly motivated to help Dr. Zackoff complete the proposed research. As a clinician in the PED, I have committed myself to providing the best care possible to our sickest patients; as an investigator and leader in Pediatric Emergency Medicine, I have committed myself to determining what best care means. We have a proven track record studying and improving the care of critically ill patients in the PED. Because of my expertise, leadership, and motivation, I am well-positioned to support Dr. Zackoff in completing the proposed research.

B. Positions, Scientific Appointments, and Honors

Positions

2002-2005	Resident in Pediatrics, Cincinnati Children's Hospital
2005-2008	Fellow, Pediatric Emergency Medicine, Cincinnati Children's Hospital
2005-present	Staff Physician, Pediatric Emergency Medicine, Cincinnati Children's Hospital
2008-2015	Assistant Professor, Pediatrics, Cincinnati Children's Hospital, University of Cincinnati
2015-present	Associate Professor, Pediatrics, Cincinnati Children's Hospital, University of Cincinnati
2021-present	Professor, Pediatrics, Cincinnati Children's Hospital, University of Cincinnati

Other Experience and Professional Memberships

2008-present	Medical Resuscitation Committee, Cincinnati Children's Hospital (co-director 2018-present)
2008-present	American Academy of Pediatrics, Fellow
2011-present	Society of Simulation in Healthcare
2018-present	Society of Pediatric Research

Honors

2012-present	Annals of Emergency Medicine, Top 50 peer reviewers
2013-present	Annals of Emergency Medicine, Senior Reviewer
2018-present	Annals of Emergency Medicine, Distinguished Senior Reviewer

C. Contributions to Science

1. **Airway management** - Mainstem intubation is common following emergency tracheal intubation in children, and the risk of mainstem intubation exacerbating critical illness is real. Confirming an endotracheal tube is not in a mainstem bronchus is challenging in children, especially under emergent conditions and for the smallest patients. During my fellowship, I was the principal investigator of a prospective study of diaphragmatic ultrasound to confirm endotracheal tube position after emergency tracheal intubation in children. We found ultrasound was not equivalent to chest radiograph, but was much faster and could be a helpful adjunct to the challenging confirmatory process. This study was innovative in design and represents an important contribution to the relevant literature, as it is one of the higher quality, prospective studies of ultrasound-based confirmation of tracheal intubation.

a) Kerrey BT, Geis GL, Quinn AM, Hornung RT, Ruddy RM. A Prospective Study Comparing Ultrasound to Chest Radiography to Confirm Correct Endotracheal Tube Placement in a Pediatric Emergency Department. *Pediatrics*. June 2009; 123; 6:e1039-1044. (PMCID 19414520)

2. **Rapid Sequence Intubation** - In my first faculty appointment I developed an expertise in the performance and improvement of pediatric rapid sequence intubation (RSI). RSI is the cornerstone of definitive airway management in the pediatric emergency department (PED). Children are at higher risk of both failed and prolonged attempts and complications. In four consecutive publications from 2012-2015, I led a team that demonstrated: (1) suboptimal performance of RSI in our PED, (2) that RSI and other critical procedures were too uncommon for providers to achieve competency based on clinical experience alone, (3) that prolonged attempts and young age were most strongly associated with complications, and (4) that a checklist-based quality improvement intervention could improve both the performance and safety of RSI without airway skills training. We have since published several additional studies on RSI. We used video-based data collection for most of this work, helping to pioneer the use of video recording for data collection during PED resuscitations. The first two RSI publications below were accompanied by editorials, and our initial publication was considered a landmark study. We have published 8 studies related to emergency airway management in children. Our most important contribution to pediatrics and emergency medicine is that poor performance of pediatric RSI may be common, but that improvement is possible through standardization without increasing clinical experience or provider skill.

- a) Kerrey BT, Rinderknecht A, Geis G, Nigrovic LE, Mittiga M. Rapid Sequence Intubation for Pediatric Emergency Patients: Higher Frequency of Failed Attempts and Adverse Effects Found by Video Review. *Annals of Emergency Medicine*. 2012, Sept, 60(3): 251-9. PMID: 22424653
- b) Mittiga MM, Rinderknecht A, Kerrey BT, Geis G. The Spectrum and Frequency of Critical Procedures Performed in a Pediatric Emergency Department- Implications of a Provider Level View. *Annals of Emergency Medicine*. 2013 Mar;61(3):263-70. PMID: 22841174
- c) Rinderknecht AS, Mittiga MR, Meinzen-Derr J, Geis G, Kerrey B. "Factors Associated with Oxyhemoglobin Desaturation during Rapid Sequence Intubation in a Pediatric Emergency Department: Findings from Multivariable Analyses of Video Review Data". *Academic Emergency Medicine*. 2015 Apr;22(4):431-40. PMID: 25779855
- d) Kerrey B, Rinderknecht A, Mittiga M, Varadarajan K, Dyas J, Geis G, Luria J, Frey M, Jablonski T, Iyer S. Reducing the incidence of oxyhaemoglobin desaturation during rapid sequence intubation in a paediatric emergency department. *BMJ Quality and Safety*. 2015 Nov;24(11):709-17. PMID: 26183713
- e) Rinderknecht AS, Dyas JR, Kerrey BT, Geis GL, Ho MH, Mittiga MR. Studying the Safety and Performance of Rapid Sequence Intubation: Data Collection Method Matters. *Acad Emerg Med*. 2016 Dec 15. (Epub ahead of print; PMID: 27976450).

3. Multidisciplinary systems of care – I am led or participated in two other airway-related projects, both of which involved the creation of multidisciplinary systems of care to improve the care of children with high acuity, low frequency airway emergencies. Early in my career, I co-lead the development of a novel system of care for children with critical airway events in a pediatric center. Children at risk for critical airway obstruction and respiratory failure are common in an academic center, and a coordinated, multidisciplinary system of care may be necessary to optimize evaluation and management. Collaborating with a physician from otolaryngology at my institution, we used in situ simulation to design and test a critical airway team (CAT). The CAT consisted of a paging system, multidisciplinary response (otolaryngology and anesthesiology), and a dedicated advanced airway cart maintained and transported by an airway respiratory therapist. For simulated cases, the CAT had significantly faster response times and fewer simulated patient deaths. The CAT has been active in our institution since 2012, serving more than 100 patients a year. The publications below describes our simulation-based study and the first several years of CAT activations. The second project was the development of a PICU-ED Team (PET) for emergency department patients at risk of peri-intubation cardiac arrest. The first study describes the multidisciplinary development of the PET and the second the initial validation of six high risk criteria for PET activation. These projects have both been multidisciplinary and highly innovative, in their use of in situ simulation in particular.

- a) Johnson K, Geis G, Oehler J, Meinzen-Derr J, Bauer J, Meyer III C, Kerrey BT. Simulation to implement a novel system of care for pediatric critical airway obstruction. *Archives of Pediatric Otolaryngology and Head and Neck Surgery*. 2012; 138(10): 907-11. (PMCID 23069820)
- b) Sterrett EC, Myer CM, Oehler J, Das B, Kerrey BT. Critical Airway Team: A Retrospective Study of an Airway Response System in a Pediatric Hospital. *Otolaryngol Head Neck Surg*. 2017 Aug 1. (PMCID: 28849711)
- c) Hoehn E, Lautz A, Dean P, Geis G, Vukovic A, Stalets E, Zackoff M, Pham T, Maxwell A, Cabrera-Thurman M, Kerrey BT. Peri-Intubation Cardiac Arrest in the Pediatric Emergency Department: A Novel System of Care for High-Risk Patients. *Pediatric Quality and Safety*, 2020 Oct 26;5(6):e365. (PMCID 33134763).
- d) Dean P, Hoehn E, Lautz A, Geis G, Vukovic A, Stalets E, Zackoff M, Pham T, Maxwell A, Cabrera-Thurman M, Kerrey BT. Identification of the Physiologically Difficult Airway in the Pediatric Emergency Department. *Academic Emergency Medicine*. 7 September 2020 (PMCID 32896033).

Complete List of Published Work in MyBibliography:

<http://www.ncbi.nlm.nih.gov/sites/myncbi/1fCFiFi37ckj/bibliography/43831499/public/?sort=date&direction=ascending>

BIOGRAPHICAL SKETCH

- Provide the following information for the Senior/key personnel and other significant contributors. Follow this format for each person. **DO NOT EXCEED FIVE PAGES.**

NAME: Zackoff, Matthew

eRA COMMONS USER NAME (credential, e.g., agency login): ZACKOFFM

POSITION TITLE: Assistant Professor

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

1. INSTITUTION AND LOCATION	2. DEGREE 3. (if applicable) 4.	5. Completion Date 6. MM/YY 7.	8. FIELD OF STUDY 9.
10. Washington University in St. Louis, St. Louis, MO	11. BS	12. 05/2008	13. Biomedical Engineering
14. Vanderbilt University School of Medicine, Nashville, TN	15. MD	16. 05/2012	17. Medicine
18. University of Cincinnati, Cincinnati, OH	19. Resident	20. 06/2015	21. Pediatrics
22. University of Cincinnati, Cincinnati, OH	23. Resident	24. 06/2016	25. Pediatrics - Chief Residency
26. Rapid Cycle Improvement Collaborative (RCIC) Cycle 23, Cincinnati, OH	27. Other training	28. 09/2016	29. Quality Improvement Science Training
30. University of Cincinnati, Cincinnati, OH	31. MEd	32. 12/2018	33. Education
34. University of Cincinnati, Cincinnati, OH	35. Fellow	36. 06/2019	37. Pediatric Critical Care Medicine

A. Personal Statement

I am currently an Assistant Professor of Pediatrics at the University of Cincinnati College of Medicine and an Attending physician in the Division of Pediatric Critical Care Medicine at Cincinnati Children's Hospital Medical Center (CCHMC). I am a funded investigator focusing on the use of innovative technology and novel educational strategies to improve clinical competence and care delivery to impact patient outcomes. This is accomplished by leveraging my background in biomedical engineering, a completed Masters in Education, and experience with improvement science methodologies to optimize eventual implementation of successful interventions. I have successfully secured funding for research endeavors, published outcomes from medical education research projects, and have disseminated my work at national and international conferences. My work to date has leveraged emerging technologies such as virtual reality and augmented reality to improve the fidelity of simulation training and provide exposure to clinical conditions and situations that were previously unable to be optimally simulated. I have a proven track record for conducting and disseminating this type of work, and I have successfully secured external funding for research endeavors in this arena.

I have led several collaborative efforts between physicians, nurses, educators, and technologists. I received funding from the American Academy of Pediatrics to create and implement an immersive virtual reality curriculum to train medical providers on the signs of impending respiratory failure – demonstrating a significant impact on intervention providers' ability to accurately identify when a patient requires an urgent escalation of care. The initial findings of this work sparked additional funding from the Council on Medical Student Education in Pediatrics for the use of immersive VR for establishing clinical competency standards – validating use of a VR simulation platform tool to set competency standards for the recognition of respiratory distress and impending respiratory failure. This work is a key step in ensuring that frontline providers called to a patient's bedside are competent to assess a patient's clinical severity status prior to being placed in that role. This work has been expanded to bedside nursing, publishing on the use of the VR simulation to impact nursing recognition of respiratory distress and respiratory failure, with additional funding through the American

Association of Critical Care Nurses to broaden our target population and track clinical application of these skills at the bedside to evaluate the impact of our intervention on patient care. In addition to VR, I have studied the impact of the addition of augmented reality (AR) to high-fidelity mannequin-based simulation – leveraging the ability of AR to add a realistic virtual patient to the simulation scenario while still allowing team interaction and use of the functionality of the simulation lab. This allows for the incorporation of mental, respiratory, and perfusion status changes, something that was not previously possible in simulation training. This work received funding from the Laerdal Foundation for the use of AR to enhance code team performance, with initial learnings from that work now published. I am currently funded through an internal institutional mechanism to implement multi-user immersive virtual reality training on sepsis – allowing multiple simultaneous users to interact to provide team-based care in a virtual environment. We are tracking the impact of this training intervention on clinical care delivery metrics for patients with sepsis. Lastly, we have implemented and are currently assessing the use of artificial intelligence (AI) in a virtual reality perfusion assessment curriculum and to simulate intra-provider communication to allow just-in-time and just-in-place training.

B. Positions, Scientific Appointments, and Honors

Positions and Appointments

2021 -	Assistant Professor, Division of Critical Care Medicine, Cincinnati Children's Hospital Medical Center, University of Cincinnati College of Medicine, Cincinnati, OH
2020 -	Fellowship Program Co-Director, Division of Critical Care Medicine, Cincinnati Children's Hospital Medical Center, University of Cincinnati College of Medicine, Cincinnati, OH
2019 - 2021	Instructor, Division of Critical Care Medicine, Cincinnati Children's Hospital Medical Center, University of Cincinnati College of Medicine, Cincinnati, OH
2016 - 2019	Clinical Fellow, Division of Critical Care Medicine, Cincinnati Children's Hospital Medical Center, University of Cincinnati College of Medicine, Cincinnati, OH
2015 - 2016	Chief Resident, Department of Pediatrics, Cincinnati Children's Hospital Medical Center, University of Cincinnati College of Medicine, Cincinnati, OH
2015 - 2016	Staff Physician, Division of Hospital Medicine, Cincinnati Children's Hospital Medical Center, Cincinnati, OH
2012 - 2015	Resident, Department of Pediatrics, Cincinnati Children's Hospital Medical Center, University of Cincinnati College of Medicine, Cincinnati, OH

Board Certifications and Clinical Licensures

<u>Board Certification</u>	American Board of Pediatrics – Critical Care Medicine, 2020 American Board of Pediatrics – Pediatrics, 2015
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<u>Licensure</u>	Medical License, Ohio, 2019 Controlled Substance Registration Certificate, DEA, 2021
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Professional Memberships

2016 -	Member, Council on Medical Student Education in Pediatrics
2015 -	Member, American Academy of Pediatrics, Section on Critical Care Medicine
2012 -	Member, Academic Pediatric Association

Honors

2021	Hidden Gem Award, Cincinnati Children's Hospital Medical Center
2021	Junior Educational Achievement Award, 10 th Annual Cincinnati Children's Hospital Medical Center Faculty Awards
2019	Fellow Teacher of the Year Award, Cincinnati Children's Hospital Medical Center
2018	Best Abstract Award for the 2018 AAP NCE Section on Critical Care Program
2016	American Society of Health-Systems Pharmacists and Cardinal Health Foundation Excellence in Medication Safety Award
2015	Beatrice C. Lampkin, M.D. Award, Cincinnati Children's Hospital Medical Center
2015	Cincinnati Children's Alumni Association Residency Award
2012	Mildred T. Stahlman Award in Pediatrics, <i>Vanderbilt University School of Medicine</i>
2012	Council on Medical Student Education in Pediatrics – Excellence Award

2009	Amos Christie Scholar, <i>Vanderbilt University School of Medicine</i>
2008	Magna cum laude, <i>Washington University in St. Louis</i>
2007	AHMB Biomedical Engineering Honor Society, <i>Washington University in St. Louis</i>

C. Contributions to Science

The focus of our research team is on the use of innovative technology and novel education strategies to improve clinical competence and care delivery to impact patient outcomes. Specifically, we are interested in the development and evaluation of virtual reality (VR) and mixed reality for clinician training. Our goal is to objectively assess the impact of enhanced training on patient outcomes, adhering to rigorous education scholarship principles to ensure the clarity of our findings and leveraging improvement science methodologies to aid with implementation of successful interventions into clinical training both for trainees and practicing clinicians.

1. Use of innovative technology to improve clinical competence:

I have explored as principal investigator the use of various innovative strategies to enhance clinical competency training. This work has pushed the potential and applicability of virtual reality, augmented, and mixed reality for clinical training. We have explored the impact of virtual reality on the recognition of respiratory distress by students, nurses, and providers; augmented reality on the performance of interprofessional code teams; and are now venturing into multi-user immersive virtual reality for situation awareness and clinical competency around the recognition and management of pediatric sepsis. This work has led to dissemination through peer reviewed publication as well as presentation at local, national, and international conferences.

- a. **Zackoff MW**, Cruse B, Sahay RD, Fei L, Saupe J, Schwartz J, Klein M, Geis GL, Tegtmeier K. Development and Implementation of Augmented Reality Enhanced High-Fidelity Simulation for Recognition of Patient Decompensation. *Simul Healthc*. 2020 Sep 8. PMID: [32910102](#).
- b. **Zackoff MW**, Lin L, Israel K, Ely K, Raab D, Saupe J, Klein M, Sitterding M. The Future of Onboarding: Implementation of Immersive Virtual Reality for Nursing Clinical Assessment Training. *J Nurses Prof Dev*. 2020 Mar 26;PubMed PMID: [32251173](#).
- c. **Zackoff MW**, Real FJ, Sahay RD, Fei L, Guiot A, Lehmann C, Tegtmeier K, Klein M. Impact of an Immersive Virtual Reality Curriculum on Medical Students' Clinical Assessment of Infants With Respiratory Distress. *Pediatr Crit Care Med*. 2020 Feb 25;PubMed PMID: [32106189](#).
- d. **Zackoff MW**, Real FJ, Cruse B, Davis D, Klein M. Medical Student Perspectives on the Use of Immersive Virtual Reality for Clinical Assessment Training. *Acad Pediatr*. 2019 Sep - Oct;19(7):849-851. PubMed PMID: [31201953](#).

2. Improving competency at teaching and enhancing the rigor of educational scholarship:

Health sciences education has traditionally been guided by teacher preference rather than by application of practices supported by evidence of effectiveness. Education researchers should be held to the same standards of theory driven work as our basic science, clinical, and translational research colleagues. The use of conceptual frameworks, theories that describe the complexities of educational and social phenomenon, are essential foundations for scholarly work in education. Ultimately, a rigorous approach to medical education scholarship is necessary to allow us to establish how our educational interventions impact the health and well-being of our patients, as well as train the next generation of educators at the bedside. I have served as the principal investigator or lead author for work expanding or enhancing educational scholarship and the capacity to teach.

- a. **Zackoff MW**, Young D, Sahay RD, Fei L, Real FJ, Guiot A, Lehmann C, Klein M. Establishing Objective Measures of Clinical Competence in Undergraduate Medical Education Through Immersive Virtual Reality. *Acad Pediatr*. 2020 Oct 20:S1876-2859(20)30566-0. PubMed PMID: [33091608](#)
- b. **Zackoff MW**, Real FJ, DeBlasio D, Spaulding JR, Sobolewski B, Unaka N, Jerardi K, Klein M. Objective Assessment of Resident Teaching Competency Through a Longitudinal, Clinically Integrated, Resident-as-Teacher Curriculum. *Acad Pediatr*. 2019 Aug;19(6):698-702. PubMed PMID: [30853578](#).
- c. **Zackoff MW**, Real FJ, Abramson EL, Li ST, Klein MD, Gusic ME. Enhancing Educational Scholarship Through Conceptual Frameworks: A Challenge and Roadmap for Medical Educators. *Acad Pediatr*. 2019 Mar;19(2):135-141. PubMed PMID: [30138745](#).
- d. **Zackoff MW**, DeBlasio D, Sobolewski B, Klein M. Implementation of point-of-care tools for assessment of teaching. *Med Educ*. 2016 Nov;50(11):1169. PubMed PMID: [27761997](#).

3. Program development and system optimization:

I have additionally worked to gain experience and expertise in program development and system improvement. This work has involved training in quality improvement and improvement science methodologies to apply towards care system improvement. My involvement has focused on clinical communication, approaches to acute care delivery, recognition and management of sepsis, and recognition and management of high-risk intubations leading to dissemination through peer reviewed publication and national presentations. I have served as a co-investigator on research related to system improvement and a lead author for characterizing approaches to optimizing care delivery.

- a. Hoehn EF, Dean P, Lautz AJ, Frey M, Cabrera-Thurman MK, Geis GL, Stalets E, **Zackoff MW**, Pham T, Maxwell A, Vukovic A, Kerrey BT. Peri-Intubation Cardiac Arrest in the Pediatric Emergency Department: A Novel System of Care. *Pediatr Qual Saf*. 2020 Oct 26;5(6):e365. PubMed PMID: [33134763](#).
- b. Soberano BT, Brady P, Yunger T, Jones R, Stoneman E, Sosa T, Stalets EL, **Zackoff MW**, Chima R, Tegtmeyer K, Dewan M. The Effects of Care Team Roles on Situation Awareness in the Pediatric Intensive Care Unit: A Prospective Cross-Sectional Study. *J Hosp Med*. 2020 Oct;15(10):594-597. PubMed PMID: [32853138](#).
- c. Vidrine R, **Zackoff MW**, Paff Z, Seger B, Satterlee M, Buenaventura E, Smith C, Pfeiffer S, Sahay RD, Stalets EL, Dewan M. Improving Timely Recognition and Treatment of Sepsis in the Pediatric ICU. *Jt Comm J Qual Patient Saf*. 2020 Feb 21;PubMed PMID: [32201121](#).
- d. **Zackoff MW**, Iyer S, Dewan M. An overarching approach for acute care delivery: extension of the acute care model to the entire inpatient admission. *Transl Pediatr*. 2018 Oct;7(4):246-252. PubMed PMID: [30460175](#); PubMed Central PMCID: [PMC6212393](#).

Complete List of Published Work in MyBibliography

<https://www.ncbi.nlm.nih.gov/myncbi/matthew.zackoff.1/bibliography/public/>