

University of Pennsylvania

Perelman School of Medicine

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Education	Aug. 2001 – May 2005	· Undergraduate Education: B.F.A.: Music Performance <i>Carnegie Mellon University, Pittsburgh PA</i>
	June 2007 – June 2011	· Medical Education: D.O. <i>Philadelphia College of Osteopathic Medicine, Philadelphia PA</i>
	July 2017 – May 2019	· Master of Science in Health Policy Research: M.S.H.P. <i>Perelman School of Medicine, U. of Pennsylvania, Philadelphia PA</i>
Postgraduate Training	July 2011 – July 2012	· Residency: Transitional Year Internship: PGY 1 <i>Mercy Catholic Medical Center, Darby PA</i>
	July 2012 – July 2015	· Residency: Anesthesia: PGY 2-4 <i>Thomas Jefferson University Hospital, Philadelphia PA</i>
	July 2015 – July 2016	· Fellowship: Critical Care: PGY 5 <i>Hospital of the University of Pennsylvania, Philadelphia PA</i>
	July 2016 – July 2017	· Fellowship: Cardiothoracic Anesthesia: PGY 6 <i>Hospital of the University of Pennsylvania, Philadelphia PA</i>
	July 2017 – July 2019	· NIH T-32 Research Training Grant (NHLBI): Postdoctoral Research <i>Perelman School of Medicine, U. of Pennsylvania, Philadelphia PA</i>
Faculty Appointments	July 2017 – July 2019	· Instructor of Anesthesiology & Critical Care <i>Department of Anesthesiology & Critical Care, Hospital of the University of Pennsylvania</i>
	July 2019 – Present	· Assistant Professor of Anesthesiology & Critical Care <i>Department of Anesthesiology & Critical Care, Hospital of the University of Pennsylvania</i>
Staff Appointments	July 2018 – July 2022	· University of Pennsylvania Lung Rescue Team <i>Evaluate and place patients on Venovenous Extracorporeal Membrane Oxygenation (VV-ECMO) for severe acute respiratory distress syndrome (ARDS)</i>
Licenses	July, 2011 – Present	· Pennsylvania State Board of Medicine
	Sept. 2018 – Present	· New Jersey State Board of Medicine

Certifications	Sept. 2015 – Present	· Board Certified (Written) American Board of Anesthesiology (ABA)
	March 2016 – Present	· Board Certified (Oral) American Board of Anesthesiology (ABA)
	Sept. 2016 – Present	· Board Certified: Critical Care Medicine: American Board of Anesthesiology (ABA)
	Sept. 2017 – Present	· Board Certified: Advanced Perioperative Transesophageal Echocardiography: National Board of Echocardiography (NBE)
Awards & Honors	June 2001 – May 2005	· Presidential Scholarship: <i>Carnegie Mellon University</i>
	May 2015	· Academic Award Scholarship: <i>Carnegie Mellon University</i>
		· 1 st Place in Original Research for "Optimization of Ventilation During Laparoscopic Surgery Using a Lung Simulator Model." Pennsylvania Anesthesia Research Award. Selected among 80 entries. <i>Pennsylvania Resident Research Conference (PARRC)</i>
	June 2015	· The Seltzer Award for Outstanding Academic Achievement. Awarded annually by the Chair of the Department of Anesthesiology to one resident displaying commitment to scholarly activity. <i>Thomas Jefferson University Hospital.</i>
		· The Tarrow Award for Significant Contribution to Anesthesia Research. Awarded annually by the Chair of Anesthesia Research to the resident displaying outstanding research accomplishment. <i>Thomas Jefferson University Hospital.</i>
	June 2016	· 1 st Place in Philadelphia Critical Care Case Presentation Competition: <i>Dynamic RCA Spasm Requiring ECMO in a Recent Liver Transplant.</i> Awarded by the Philadelphia Drinker Society
June 2017	· Kaplan Award for Adult Cardiothoracic Anesthesiology. Awarded annually by the Division of Cardiothoracic Anesthesiology to the fellow demonstrating outstanding achievement in adult cardiothoracic anesthesia. <i>Hospital of the University of Pennsylvania</i>	
Oct. 2019	· Semi-finalist in the <i>Centers for Medicare and Medicaid Services (CMS) Artificial Intelligence (AI) Health Outcomes Challenge</i> (25 semi-finalists selected from 300 applications).	
Memberships in Professional Societies	July, 2015 – Present	· American Society of Anesthesiology (ASA)
	July, 2016 – Present	· Trauma Anesthesiology Society (TAS)
	July, 2018 – Present	· American Heart Association (AHA)
	July, 2020 – Present	· American Society of Echocardiography (ASE)
Leadership Roles (UPenn)	July 2020 – Present	· Aortic Disease Team Committee. Responsibilities: quality and outcomes improvement among patients undergoing aortic surgery at Penn
Leadership Roles (National)	July 2019 – Present	· The Young Leadership (Early Career) Committee of the Council on Cardiovascular Surgery and Anesthesia (CVSA) of the American Heart Association (AHA). Responsibilities: award review, grant review, moderate resident abstract competition
	July 2020 – Present	· Society of Cardiovascular Anesthesiologists (SCA) Research Committee. Responsibilities: grant review

Grant Funding

Grant Funding (Pending)	July 1, 2023 – June 30, 2028	<ul style="list-style-type: none">· National Institutes of Health (NIH) National Heart, Lung, and Blood Institute (NHLBI) Mentored Patient-Oriented Research Career Development Award (Parent K23 Independent Clinical Trial Required) PA-20-206.· Role: PI: MacKay. Mentor: Groeneveld· Date submitted: 11/12/2022· Impact score of 20 received: 03/07/2023
Grant Funding (Current)	Jan. 1, 2023 – Dec. 31, 2025	<ul style="list-style-type: none">· Philips Industry Funding – Testing Automated Echocardiography· Funding: \$164,619.00· Role: PI: MacKay
	Mar. 1, 2023 – Feb. 28, 2025	<ul style="list-style-type: none">· UPenn Translational Biomedical Engineering – Developing a Scalable, Deep Learning Pipeline to Generate a Large, Hierarchical, Labeled, 2D Echocardiographic Dataset· Funding: \$50,000.00· Role: PI: MacKay
	July 1, 2023 – June 30, 2024	<ul style="list-style-type: none">· Society of Cardiovascular Anesthesiologists (SCA), Society of Thoracic Surgeons (STS), Participant User File (PUF) Grant· Funding: \$15,000.00· Role: PI: MacKay
Grant Funding (Completed)	Jan. 1, 2021 – Dec. 31, 2022	<ul style="list-style-type: none">· Foundation for Anesthesia Education and Research (FAER) Mentored Research Training Grant (MRTG):· Funding: \$250,000.00.· Role: PI: MacKay. Mentor: Groeneveld.
	July 1, 2019 – June 30, 2022	<ul style="list-style-type: none">· Department of Anesthesiology and Critical Care University of Pennsylvania. Internal research startup funding.· Funding \$60,000.00.· Role: PI: MacKay. Mentor: Groeneveld.
	July 1, 2019 – June 30, 2021	<ul style="list-style-type: none">· National Institutes of Health (NIH) Loan Repayment Program (LRP). National Heart, Lung and Blood Institute (NHLBI)· Funding: \$66,946.40· Role: PI: MacKay. Mentor: Groeneveld. NIH LRP grant number NPYA5192.
	Nov 1, 2019 – Mar. 31, 2020	<ul style="list-style-type: none">· University of Pennsylvania Health System Funding for CMS Artificial Intelligence Health Outcomes Challenge (Stage I submission).· Funding: \$30,000.00.· Role: PI: MacKay.
	July 2017 – July 2019	<ul style="list-style-type: none">· National Institutes of Health (NIH); National Heart, Lung and Blood Institute (NHLBI) T-32 Training Grant in Health Services Research and Critical Care Medicine.· Grant Number: 5T32HL098054.· Role: Trainee: MacKay. Mentor: Halpern.

Academic Teaching

Clinical Responsibilities (daily clinical teaching)

- Point-of-Care Transthoracic Echocardiography: Responsible for hands-on teaching of critical care fellows and cardiothoracic anesthesia fellows in the skill of bedside, point-of-care transthoracic echocardiography.
- Advanced Perioperative Transesophageal Echocardiography: Responsible for hands-on teaching of cardiothoracic anesthesia fellows in the skill of perioperative and intraoperative transesophageal echocardiography.
- Clinical Training: Instruct resident and cardiac anesthesia trainees on the intraoperative anesthetic and hemodynamic management of cardiac surgery patients.

Academic Teaching (PSOM)

- Lecture(s): STATA Programming Basics (HPR II) (2022 – present)
- Lecture: Target Trials (HPR II): 2023

Intramural Lectures Resident / Fellow Trainees

- Clinical Lecture: "Echocardiography for the Trauma Patient." (2017 – present)
- Clinical Lecture: "Transthoracic Point-of-Care Echocardiography." (2019 – present)
- Statistics Lecture: "Scientific Inquiry." (2020 – 2021)
- Statistics Lecture: "Basic Statistics." (2022)
- Clinical Lecture: "Echocardiographic Evaluation of Prosthetic Valves." (2017 – 2019)
- Clinical Lecture: "Echocardiography for Mechanical Cardiopulmonary Devices" (2017 – 2020)

Invited Talks

Regional & National

- **MacKay, E. J.**, "Implementation Science – Perioperative Applications." National, Conference. Society of Cardiovascular Anesthesiologists (SCA), Portland, OR. 05/06/2023.
- **MacKay, E. J.**, "Is This Aortic Valve Repairable? The When / Who / What / How Answer." National. Society of Cardiovascular Anesthesiologists (SCA) ECHO Week, Atlanta, GA 02/16/2023.
- **MacKay, E. J.**, "A Population-Based Look at Transesophageal Echocardiography and Clinical Outcomes." Regional; Grand Rounds. Boston Medical Center (virtual), 12/22/2022.
- **MacKay, E. J.**, Panelist. "'The Valve Leaks, What do I do?' Approach to Recurrent Aortic Insufficiency Following Aortic Valve Repair." International; Conference. North American Aortic Valve Repair Symposium. Philadelphia PA. 09/10/2022.
- **MacKay, E. J.**, Panelist. "Introduction to Surgical Techniques for Aortic Root and Valve Reconstruction." International; Conference. North American Aortic Valve Repair Symposium, Philadelphia PA. 09/09/2022.
- **MacKay, E. J.**, "A Population-Based Look at Transesophageal Echocardiography and Clinical Outcomes." Regional; Grand Rounds. Department of Anesthesiology, Perioperative Medicine, and Pain Management, University of Miami. Invited Talk (virtual). 08/26/2022.
- **MacKay, E. J.**, "Leveraging Data for Perioperative Research." Regional; Grand Rounds. Department of Anesthesiology and Critical Care, University of Rochester Medical Center. 03/10/2022.
- **MacKay, E. J.**, Seminar: State of the Art Future Directions. Talk, "Artificial Intelligence and Echocardiography – Pro." National; Conference. Society of Cardiovascular Anesthesiologists (SCA) ECHO Week. (Virtual). 02/20/2022.
- **MacKay, E. J.**, Seminar: Decision Making in Aortic Valve Surgery. Talk, "Aortic Valve Repair: Pre-Op and Post-Op Assessment." National; Conference. Society of Cardiovascular Anesthesiologists (SCA) ECHO Week. (Virtual). 02/18/2022.
- **MacKay, E. J.**, "Big Data in Healthcare and Applications to Research." Regional; Grand Rounds, Department of Anesthesiology and Critical Care, University of Kansas. (Virtual). 02/01/2022.
- **MacKay, E. J.**, "A Population-Based Look at Perioperative Echocardiography." Internal (UPenn) Grand Rounds. Department of Anesthesiology and Critical Care, University of Pennsylvania. 01/06/2022.
- **MacKay, E. J.**, "Jumpstarting Your Career in Cardiovascular Surgery and Anesthesiology: Early Career and Promotion." National; Conference. American Heart Association (virtual). 11/13/2021.
- **MacKay, E. J.**, "Studying Intraoperative Echocardiography in Cardiac Surgery – The Role of Causal Inference." Regional; Grand Rounds. Department of Anesthesiology, Perioperative Care and Pain Medicine, New York University, Langone Health. Invited talk (virtual). 08/29/2021.
- **MacKay, E. J.**, "Studying Intraoperative Echocardiography – How Causal Inference Can Fill the Gap." Regional; Cardiac Anesthesia Group. Division of Adult Cardiothoracic Anesthesiology, Department of Anesthesia, Perioperative and Pain Medicine, Stanford University (virtual). 06/10/2021.
- **MacKay, E. J.**, "Maintaining Clinical Skill as a Junior Investigator." National; Conference. American Heart Association (AHA) (virtual). 11/16/2020.
- **MacKay, E. J.**, Bavaria, J. E., "Bicuspid Aortic Valve Repair and Outcomes" Subcategory: "Repair or Replace: Case-Based Discussions of Failures/Difficult Scenarios." International; Conference. Aortic Valve Repair Collaborative: European and North American Chapters. Aortic Valve Repair Summit, Ottawa, ON, Canada, 06/24/2017.
- **MacKay, E. J.**, Bavaria, J. E., "Complex Heart Valve Surgery: Echocardiographic Correlation." National; Conference. Cardiovascular Institute of Philadelphia (CVI): 23rd Annual Cardiology Update, Philadelphia, PA. (Oral Presentation Collaborator). 10/23/2016.

Bibliography

PubMed Bibliography: <https://www.ncbi.nlm.nih.gov/myncbi/emily.mackay.1/bibliography/public/>

Google Scholar Bibliography: <https://scholar.google.com/citations?hl=en&user=4CfYOOkAAAAJ>

Selected Publications

- Peer-Reviewed Publications**
- **MackKay EJ**, Zhang B, Shah RM, Augoustides JG, Groeneveld PW, Desai ND. Predictors of Intraoperative Echocardiography: Analysis of The Society of Thoracic Surgeons Database. *The Annals of Thoracic Surgery*. (2023): S0003-4975.
 - Zhang, B, **MackKay, EJ**, and Baiocchi, M. "Statistical matching and subclassification with a continuous dose: characterization, algorithm, and application to a health outcomes study." *The Annals of Applied Statistics* 17.1 (2023): 454-475.
 - Zhang B, Heng S, **MackKay EJ**, Ye T. Bridging preference-based instrumental variable studies and cluster-randomized encouragement experiments: Study design, noncompliance, and average cluster effect ratio. *Biometrics*. 2022 Dec;78(4):1639-50.
 - **MackKay EJ**, Zhang B, Neuman MD, Augoustides JG, Desai ND, Groeneveld PW. Impact of Hospital Practice and Staffing Differences on Transesophageal Echocardiography Use in Cardiac Valve or Coronary Artery Bypass Graft Surgery. *Journal of Cardiothoracic and Vascular Anesthesia*. 2022 Nov 1;36(11):4012-21.
 - **MackKay EJ**, Zhang B, Augoustides, JG, Groeneveld PW, Desai ND. Association of Intraoperative Transesophageal Echocardiography and Clinical Outcomes After Open Cardiac Valve and Aortic Surgery. *JAMA Network Open*. 2022;5 (2), e2147820-e2147820. PMID: 35138396.
 - **MackKay, EJ**, Stubna, MD, Chivers, C, Draugelis, ME, Hanson, WJ III, Desai, ND, Groeneveld, PW. Application of machine learning approaches to administrative claims data to predict clinical outcomes in medical and surgical patient populations. *PLOS One*. 16 (6), e0252585
 - **MackKay EJ**, Salmon, MK, Fatuzzo, MR, Neuman, MD, Desai, ND, Groeneveld, PW, Augoustides, JG. Validation of Claims Data for the Identification of Intraoperative Transesophageal Echocardiography During Cardiac Surgery. Article in Press. *Journal of Cardiothoracic and Vascular Anesthesia (JCVA)*. 2021 Nov;35(11):3193-3198. PMID: 34023202.
 - **MackKay EJ**, Zhang, B, Heng, S, Ye, T, Neuman, MD, Augoustides, JG, Desai, ND, Groeneveld, PW. Association Between Transesophageal Echocardiography (TEE) During Coronary Artery Bypass Graft (CABG) Surgery and Clinical Outcomes. *Journal of the American Society of Echocardiography (JASE)*. 34:6;571-581. PMID 33508414
 - **MackKay EJ**, Neuman MD, Fleisher LA, Patel PA, Gutsche JT, Augoustides JG, Desai, ND, and Groeneveld, PW. Transesophageal Echocardiography, Mortality, and Length of Hospitalization after Cardiac Valve Surgery. *J Am Soc Echocardiogr*. 2020;33:756-62 e1. PMID: 32222480
 - **MackKay EJ**, Werner, RM, Groeneveld, PW, Desai, ND, Reese, PP, Gutsche, JT, Augoustides, JG, Neuman, MD. Coronary Artery Bypass Graft Surgery: With vs Without Transesophageal Echocardiography. *Journal of Cardiothoracic Vascular Anesthesia*. 2019. 34 (3), 687-695. PMID: 31558399
 - **MackKay EJ**, Groeneveld PW, Fleisher LA, Desai ND, Gutsche JT, Augoustides JG, Patel PA and Neuman MD. Practice Pattern Variation in the Use of Transesophageal Echocardiography for Open Valve Cardiac Surgery. *Journal of Cardiothoracic Vascular Anesthesia*. 2018. 33 (1), 118-133. PMID: 30174265

- **MacKay EJ**, Stubna MD, Holena DN, Reilly PM, Seamon MJ, Smith BP, Kaplan LJ and Cannon JW. Abnormal Calcium Levels During Trauma Resuscitation Are Associated With Increased Mortality, Increased Blood Product Use, and Greater Hospital Resource Consumption: A Pilot Investigation. *Anesth Analg*. 2017;125:895-901. PMID: 28704250

Preprints

- Zhang, B, **Mackay, EJ**, & Baiocchi, M. (2020). Statistical matching and subclassification with a continuous dose: characterization, algorithms, and inference. arXiv preprint arXiv:2012.07182.
- **MacKay EJ**, Zhang B, Heng S and Ye T. Protocol for a Retrospective, Comparative Effectiveness Study of the Association Between Transesophageal Echocardiography (TEE) Monitoring Used in Coronary Artery Bypass Graft (CABG) Surgery and Clinical Outcomes. medRxiv.org 2020:2020.05.23.20110528.

All Publications

<https://scholar.google.com/citations?hl=en&user=4CfYOOQkAAAAJ>

Book Chapters

- **MacKay, EJ**, Cannon, JW, Extracorporeal Membrane Oxygenation in the Unstable Trauma Patient (Chapter). *Endovascular Resuscitation and Trauma Management* (Springer; 1st Edition. Publication: 2019).
- **MacKay, EJ** Community-Acquired Pneumonia (Chapter). Fleisher, L. A. & Roizen, M.F. *Essence of Anesthesia Practice* (Text). Elsevier Health Sciences (4th Edition. Publication: 2017).
- **MacKay, EJ** Hospital-Acquired Pneumonia (Chapter). Fleisher, L. A. & Roizen, M.F. *Essence of Anesthesia Practice* (Text). Elsevier Health Sciences (4th Edition. Publication: 2017).
- **MacKay, EJ**, Silvay, G, Augoustides, JG. Intra-Aortic Balloon Pump (Chapter). *Reducing Mortality in the Perioperative Period*. Landoni, G. Ruggeri, L. & Zangrillo, A. (2nd Edition. Publication: 2017).
- **MacKay, EJ**, Silvay, G, Augoustides, JG. Intra-Aortic Balloon Pump (Chapter). *Reducing Mortality in the Perioperative Period*. Landoni, G. Ruggeri, L. & Zangrillo, A. (2nd Edition. Publication: 2017).

Professional Service

Professional Service (National Committees)

- Young Leadership (Early Career) Committee of the Council on Cardiovascular Surgery and Anesthesia (CVSA) of the American Heart Association (AHA).
- Society of Cardiovascular Anesthesiologists (SCA) Research Committee. Responsibilities: grant review

Professional Service (Ad-Hoc Reviewer)

- *Journal of Clinical Anesthesia* (Reviewer)
- *Respiratory Care* (Reviewer)
- *Anesthesia & Analgesia* (Reviewer)
- *Journal of Cardiothoracic and Vascular Anesthesia* (Reviewer)