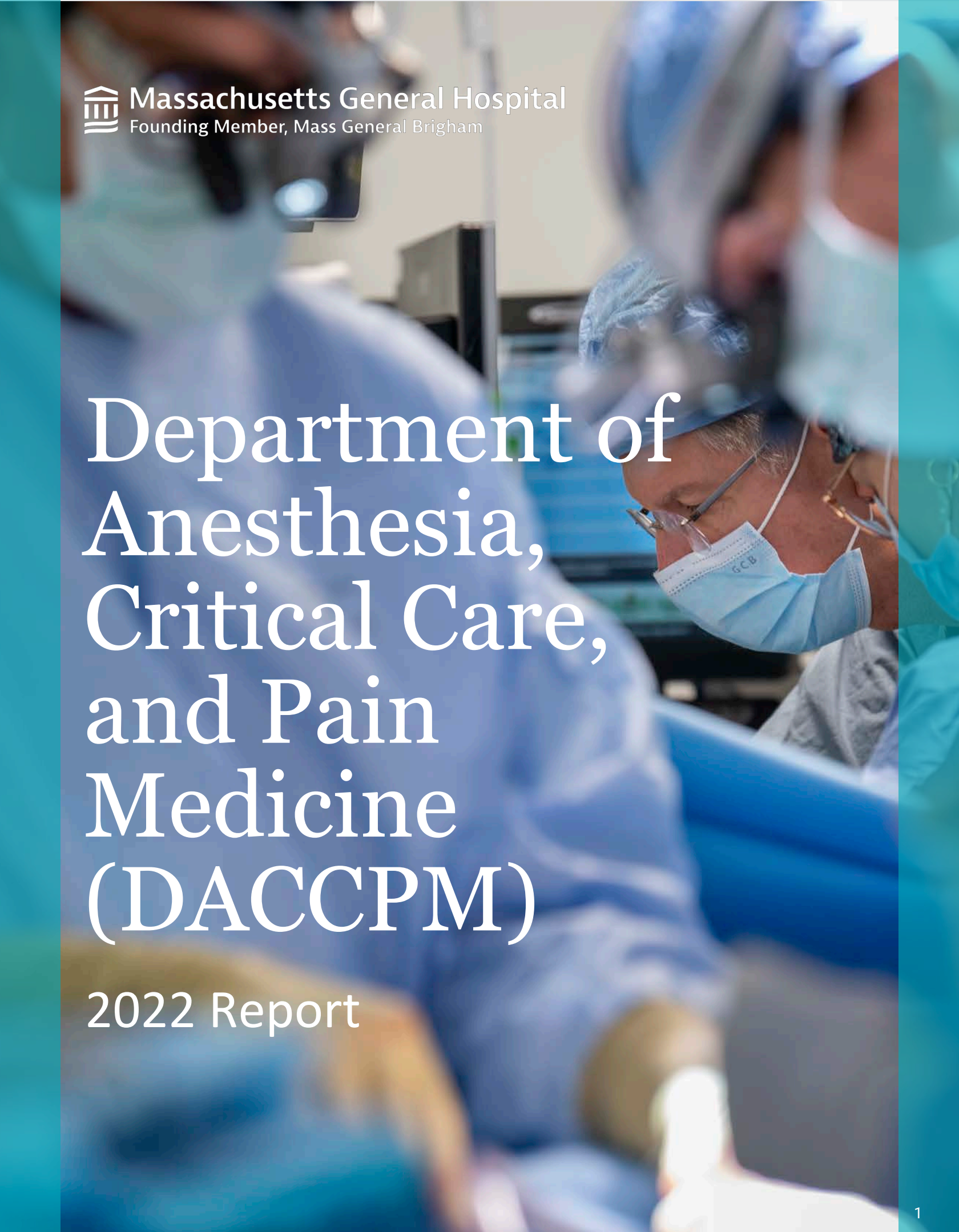


Department of Anesthesia, Critical Care, and Pain Medicine (DACCPM)

2022 Report

Research & Innovation

Research & Innovation

(Left) Patrick Purdon, PhD, and (right) Emery Brown, MD, PhD, anesthesiologists

Overview and Mission

The department's research activities encompass a broad range of disciplines with active research units in the areas of cardiac and pulmonary pathophysiology, molecular and system neuroscience, pharmacology, pain neurobiology, neuroimaging, stem cell research, genetics, comparative outcome research, biomedical engineering, and new drug and medical device development.

Our strategic research priorities:

1. Expanding a premier research team
2. Strengthening a platform that promotes integration between basic science and clinical research
3. Using research invention and innovation to advance translational research and support basic science and clinical research

New Research Programs

1.

Department Research Council. The Department's Research Council drafted a Departmental Research Blueprint for the next decade. This blueprint will serve as a guiding document for future strategies and operational plans for research in the department.

2.

Neuroscience Research Center. Dr. Emery Brown and his research group are working with the Massachusetts Institute of Technology to establish a Neuroscience Research Center. This center will conduct both basic science and clinical research on the brain mechanisms of general anesthesia.

3.

Neuroimmune Research on Pain and Cognitive Disorders. Dr. Shen Shiqian has established and now leads a new laboratory that conducts neuroimmune research on pain and cognitive disorders. The lab is now situated in the Mass General location in the Charlestown Navy Yard.

Anesthesia Research Center

115
research projects supported

109
investigators involved in collaborations

Type of Research Projects

60%
outcomes and observational research

29%
prospective clinical research

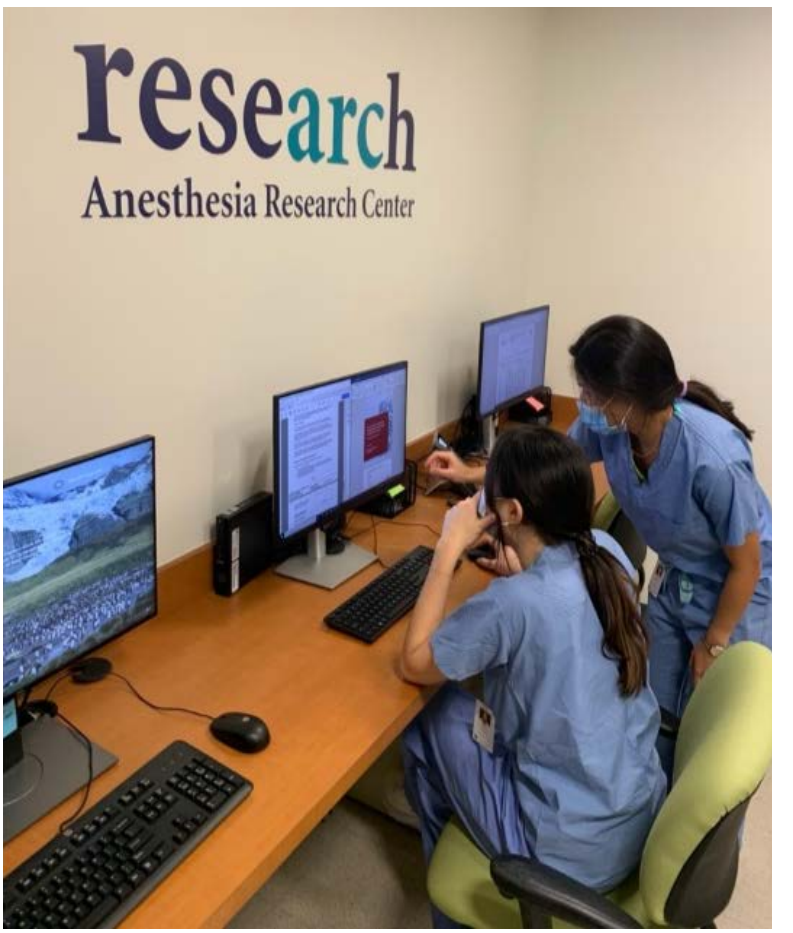
6%
basic research and administration

5%
grant submissions

Vision & Mission

By bringing together clinical research coordinators/fellows, data scientists, statisticians, and research administrators with extensive research experience, the Anesthesia Research Center at Mass General fosters high-quality, innovative clinical research that enhances and advances the field of anesthesiology.

It provides a resource-rich research infrastructure that facilitates clinical research endeavors, ensures regulatory compliance, trains the next generation of clinician-scientists, and ultimately supports high-impact clinical investigations.



Research Spotlights

Keith Miller, PhD
Investigator, Mass General
Professor, Harvard Medical School

Cryo–EM Structures pf GABA(A) Receptors

For four decades, research led by Dr. Keith Miller and his collaborators has produced findings that explain the molecular mechanisms by which general anesthetics act to produce the state of anesthesia and its side effects. This year, Dr. Miller and his collaborators showed the first Cryo–EM structures of the extrasynaptic subfamily of GABA(A) receptors. These new structures begin to define how their five subunits are assembled from 19 known subunits. The significance is that neurotransmitters, anesthetics, and other drugs bind between pairs of subunits.

Miller KW, et al. Differential Assembly Diversifies GABAA Receptor Structures and Signalling. Nature. 2022 Apr;604(7904):190-194. doi: 10.1038/s41586-022-04517-3. PMID: 35355020.

Gary Brenner, MD, PhD
Physician Investigator, Mass General
Associate Professor, Harvard Medical School

Schwannoma and Attenuated Salmonella Typhimurium

NF2 and schwannomatosis are genetic disorders associated with schwannomas, benign nerve sheath tumors that cause pain, neurologic deficits, and death. Surgical resection, the standard of care, has major limitations. Dr. Gary Brenner and his team demonstrated that injection of schwannomas with an attenuated strain of Salmonella typhimurium controls tumor growth and leads to systemic anti-tumor immunity that targets uninjected tumors and prevents new tumors. These results support the translation of S. typhimurium schwannoma immunotherapy to clinical trials.

Brenner GJ, et al. Intratumoral Injection of Schwannoma with Attenuated Salmonella Typhimurium Induces Antitumor Immunity and Controls Tumor Growth. *Proc Natl Acad Sci USA.* 2022 Jun 14. doi: 10.1073/pnas.2202719119.

Shiqian Shen, MD
Physician Investigator, Mass General
Associate Professor, Harvard Medical School

Neuro-immune Interactions and the Gut Microbiome

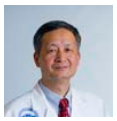
Dr. Shen Shiqian's group investigates the mechanisms of neuro-immune interactions influenced by the gut microbiome, using animal behavior as readouts, including pain and cognitive dysfunction. They've established multi-omics and imaging modalities to query neural dynamics over multiple temporal and spatial scales. Last year, his group published 12 papers, including four as corresponding or co-corresponding authors. Dr. Shen was awarded an NIH R01 with one R61 grant pending for the Notice of Award.

Patrick Purdon, PhD
Associate Investigator, Mass General
Associate Professor, Harvard Medical School

The Neural Mechanisms of Anesthesia

Dr. Patrick Purdon and his team have been studying the neural mechanisms of anesthesia, developing novel neural signal processing methods, and investigating brain dynamics during aging, Alzheimer’s disease, child development, and sleep. More recently, the team is studying the relationships among anesthetic exposure, opioid administration, brain oscillations, and post-operative trajectories for cognition and pain using both prospective and retrospective clinical data sources.

Grants



Jianren Mao, MD, PhD
Title: BACPAC- Biomarkers for Evaluating Spine Treatments (BEST) Study
Sponsor: University of North Carolina at Chapel Hill

Xiaodong Bao, MD, PhD
Title: Hypotension Prediction Index Software Guided Hemodynamic Management for Noncardiac Surgery Patients—Blood Pressure Trial
Sponsor: Edwards Lifesciences

Joseph Cotten, MD, PhD
Title: Evaluation of the Drug-Drug Interactions of Fentanyl with Stimulants in the Context of Overdose
Sponsor: Clear Scientific

Timothy Houle, PhD
Title: Forecasting Migraine Attacks
Sponsor: NIH

Edward Bittner, MD, PhD
Title: Development of a Novel Cuff-Less Wrist Wearable Continuous Blood Pressure Monitor
Sponsor: Dynocardia, Inc.

Fumito Ichinose, MD, PhD
Title: Evaluation of the Effects of Guanylate Cyclase-modulating Agent on Neurological Outcomes After Cardiac Arrest
Sponsor: Cyslerion Therapeutics, Inc.

Samuel Smith, MD, MPH
Title: MGH Magic Wand: Monitoring Intraoperative Blood Loss
Sponsor: MGH—Wellman Center for Photomedicine

Hovig Citilian, MD
Title: MGH Magic Wand: Universal Linear Ultrasound Transducer Needle Guide
Sponsor: MGH—Wellman Center for Photomedicine

Aranya Bagchi, MBBS
Title: Magic Wand: Detecting Tissue Hypoxia
Sponsor: MGH—Wellman Center for Photomedicine

Eric Melonakos, PhD
Title: The Roles of Genetically Distinct Cortical Neuron Types in General-Anesthesia- and Sleep-Induced Slow Waves
Sponsor: NIH

Lorenzo Berra, MD
Title: The Inhaled Sedation vs Propofol in Respiratory FailurE – ICU (INSPiRE-ICU) 2 Study
Sponsor: Sedana Medical AB (publ), Corp.

Paul Lichtenegger, MD
Title: Extracorporeal Membrane Oxygenation and Phototherapy for the Treatment of Carbon Monoxide Poisoning in a Porcine Model of Acute Respiratory Distress Syndrome
Sponsor: Max Kade Foundation

Hilary Gallin, MD
Title: FastLine: Single-Handed Venous Access Device
Sponsor: Mass General Brigham

Christa Nehs, PhD
Title: Metabolic Interventions for Sleep, Anesthesia-related Neurocognitive Disorders and Alzheimer's Disease
Sponsor: NIH

Tina McKay, MD
Title: Investigation of a Novel Biomarker of Postoperative Delirium
Sponsor: NIH

Jianren Mao, MD, PhD
Title: Task Order #2: EPPIC HEAL Initiative (EPPIC-Net): Master Site Clinical Trial Agreement (F. Maurizio, CCC PI)—Hub Site (J. Mao)
Sponsor: Mass General

Brian Wainger, MD, PhD
Title: Identifying Phytocannabinoids for Treating Pain
Sponsor: President and Fellows of Harvard College

Patrick Purdon, PhD
Title: Characterizing Brain Dynamic Biomarkers of Fentanyl Using Intracranial and High-density Electroencephalogram in Humans
Sponsor: NIH

Susana Vacas, MD, PhD
Title: Mechanisms Mediating Postoperative Neurocognitive Disorders
Sponsor: NIH

Zhongcong Xie, MD, PhD
Title: Postoperative Delirium and Alzheimer's Disease Related Dementias
Sponsor: NIH

Ran Liu, PhD
Title: Model-based Optimization of Pain Management in Surgical Patients
Sponsor: NIH

Julian Goldman, MD
Title: A Robot-Assisted Perfusion System to Improve Patient Safety in the Cardiac OR
Sponsor: Brigham & Women's

Shiqian Shen, MD
Title: Inhibiting RIPK1 with Necrostatin-1 for Safe and Effective Pain Treatment
Sponsor: NIH

Aranya Bagchi, MBBS
Title: Hepcidin-Ferroportin-Iron Axis in Cardiac Surgery-associated Acute Kidney Injury
Sponsor: NIH

Brian Wainger, MD, PhD
Title: From Nerve to Brain: Toward a Mechanistic Understanding of Spinal Cord Stimulation in Human Subjects
Sponsor: NIH

Amit Bardia, MD, MPH
Title: Targeting Surgical Site Infections through a Perioperative Antibiotic Clinical
Sponsor: AHRQ

Weihua Ding, MD
Title: Thalamic Reticular Nucleus Dysfunction Contributes to Sleep Lose Induced Hyperalgesia
Sponsor: Mass General

Research Articles on *Advances in Motion*

Human Stem Cell-Derived Organoids Facilitates Research Into Als Pathogenesis, Therapy

Researchers at Mass General, including Dr. Brian Wainger, generated the first cultured organoids that allow comparison of neuromuscular junctions derived from amyotrophic lateral sclerosis patients and from controls.

Read the article

Pandemic-Related Stressors May Impact Brain Health of Uninfected Individuals

A team of Mass General DACCPM researchers recently explored the effects of COVID-19 pandemic-related stressors on the brain health of individuals who were not infected.

Read the article

COVID-19 ARDS Has Distinct Phenotypes

Researchers investigated phenotypic groupings among patients with ARDS secondary to COVID-19. They found two distinct phenotypes—one associated with greater mortality is characterized by renal and cardiac impairment, altered coagulation and only mild relative hyperinflammation.

Read the article

Numerous Genetic Variants Are Linked with Differences in Food Intake

Researchers at Mass General, including Richa Saxena, PhD, principal investigator in the Department of Anesthesia, have identified 26 genomic regions that may affect overall variation in dietary intake.

Read the article

High-Dose Inhaled Nitric Oxide Safe, Effective For Non-Intubated Covid-19 Patients

Researchers at Mass General, including Lorenzo Berra, MD, anesthesiologist and medical director for Respiratory Care at Mass General, and Bijan Safaee Fakhr, MD, anesthesia research fellow, initiated a study that investigated the effectiveness and safety of inhaling 160 ppm nitric oxide (NO) gas twice daily for 30 minutes in 29 spontaneously breathing, non-intubated hospitalized patients with mild to moderate COVID-19-induced pneumonia.

Read the article

Inhaled Nitric Oxide Improves Oxygenation in Pregnant Patients with COVID-19 Pneumonia

Pneumonia caused by COVID-19 is particularly threatening to pregnant patients, as it can quickly progress to oxygen insufficiency in the blood and bodily tissues

Led by Mass General, a team of four Boston medical centers investigated the use of high-dose inhaled nitric oxide gas (iNO) as a potential respiratory therapy.

Read the article