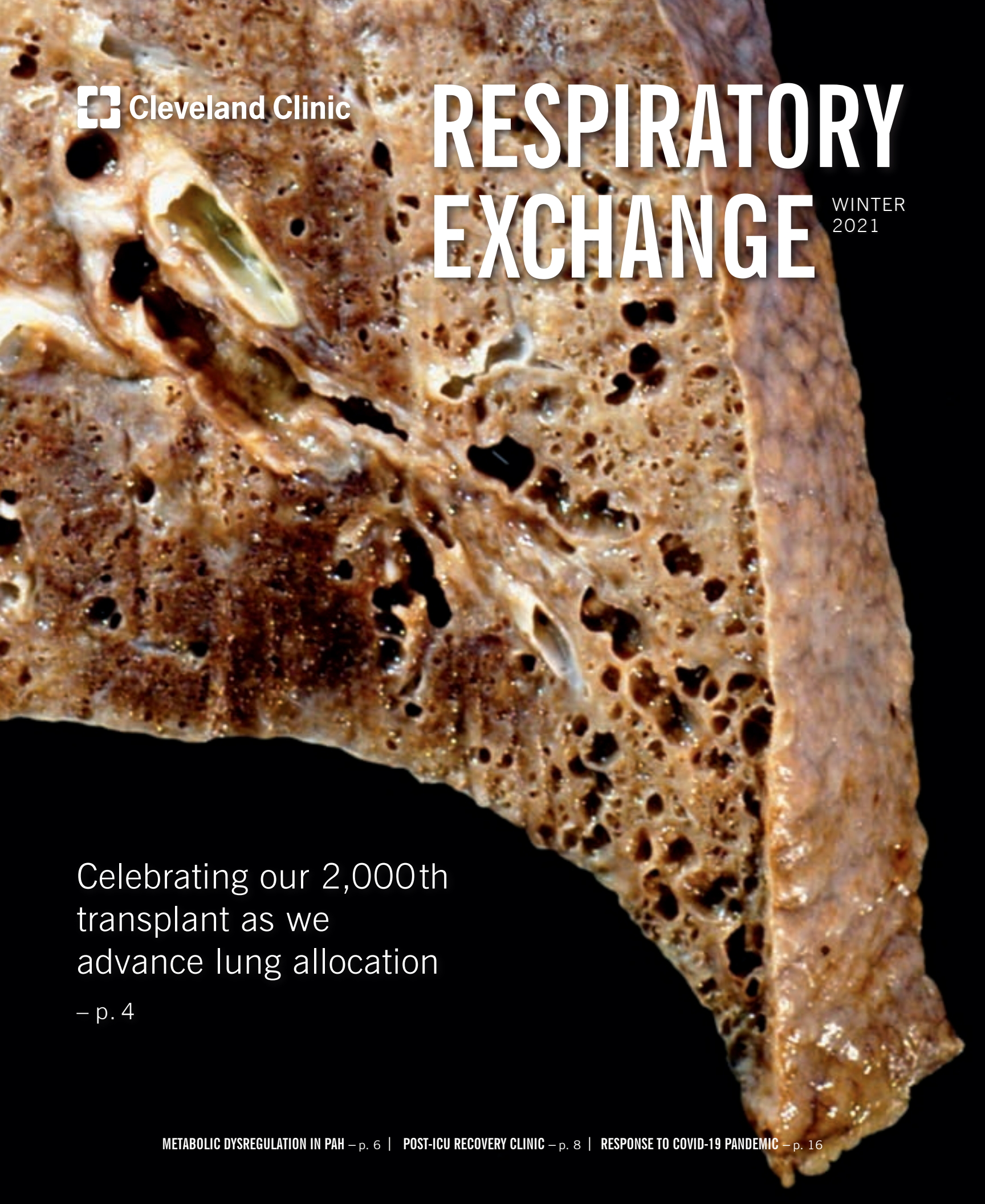


Cleveland Clinic

RESPIRATORY EXCHANGE

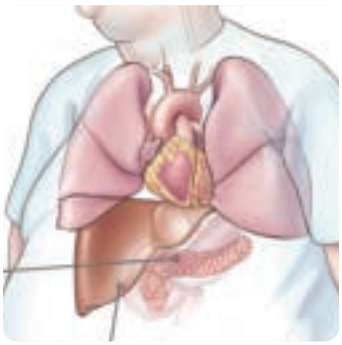
WINTER 2021

Celebrating our 2,000th transplant as we advance lung allocation

– p. 4

At the Respiratory Institute, specialists in pulmonology, allergy and immunology, infectious disease, and critical care medicine work in close collaboration to diagnose and manage the full spectrum of pulmonary and allergic disorders, serving more than 200,000 patients annually. The institute is part of Cleveland Clinic, a nonprofit, multispecialty academic medical center integrating outpatient and hospital care with research and education for better patient outcomes and experience. More than 4,500 staff physicians and researchers provide services through 20 patient-centered institutes. Cleveland Clinic is currently ranked as one of the nation's top hospitals by *U.S. News & World Report*.

INSIDE



ON THE COVER: Coronal section from an explanted lung in a patient transplanted for idiopathic pulmonary fibrosis

DEAR COLLEAGUES,

RAED DWEIK, MD, MBA
Chairman, Cleveland Clinic
Respiratory Institute

It goes without saying, 2020 was a historic year as we navigated the COVID-19 pandemic, the reverberations of which will be felt for years to come. While reflecting on the year, I am awed by the responsiveness we showed to one another and to our mission. We made some adjustments along the way, but central to everything has been the care of patients.

With that in mind, I am eager to share this issue of *Respiratory Exchange*. It embodies the clinical, research and training initiatives across Cleveland Clinic's Respiratory Institute, which comprises nearly 200 staff physicians across four interdisciplinary departments: pulmonary medicine, critical care medicine, allergy and clinical immunology, and infectious disease.

In this issue — Our cover story announces an extraordinary effort to develop a new risk-modeling approach to prioritizing patients for lung transplant. The work was recently awarded a four-year, $3 million R01 grant from the National Institutes of Health. This is a fitting cover for this issue as we reached the milestone of 2,000 lung transplants in July 2020.

But that isn't the only research effort of note. Another article highlights a recent study that challenges the prevailing literature on insulin resistance in pulmonary arterial hypertension. In addition, our Food Allergy Center of Excellence leads the search for new methods of treating food allergies, such as with early peanut oral immunotherapy.

As expected, this issue also reflects on COVID-19's impact on our day-to-day work. We summarize the monumental task of preparing for a surge in critical care patients and review the benefits of our Post-ICU Recovery Clinic. Even our pulmonary and critical care fellowship program was affected by the pandemic, hosting its first Education Day of the new academic year virtually. You'll find many more valuable stories and insights within these pages.

Finally, I would be remiss if I didn't mention the generosity that has enabled the appointment of two endowed chairs in our program. I am pleased to announce that Carli Lehr, MD, received the Gregory and Maureen Church Term Chair in Lung Transplantation Research, and I am humbled to have been the recipient of the E. Tom and Erika Meyer Chair in Pulmonary Medicine. Gifts such as these enable our team to lead clinical and research advancements to improve patient care today and into the future.

Sincerely,

RAED DWEIK, MD, MBA
Chairman, Cleveland Clinic Respiratory Institute | E. Tom and Erika Meyer Chair in Pulmonary Medicine

ADVANCING THE U.S. LUNG TRANSPLANT ALLOCATION SYSTEM

KEY POINTS

Patients today are prioritized for lung transplant by Lung Allocation Score (LAS), which calculates predicted waitlist mortality and post-transplant survival.

LAS assumes that the relationship between clinical risk factors and mortality risk is fixed. Clinical observation indicates otherwise.

Maryam Valapour, MD, MPP, and a team of researchers have received an NIH grant to develop a more dynamic lung-allocation system using microsimulations.

This new system will incorporate day-to-day changes in candidates' pulmonary, cardiac, renal and other clinical measures.

Maryam Valapour, MD, MPP, and a multidisciplinary team of researchers have received a four-year, $3 million R01 grant from the National Institutes of Health (NIH) to develop an improved risk-modeling approach to help prioritize patients with advanced lung disease for lung transplant.

The current U.S. lung allocation system

Patients with advanced lung disease are prioritized for lung transplant through the Lung Allocation Score (LAS) system. The LAS estimates the benefit a patient may derive from a transplant by calculating predicted waitlist mortality and post-transplant survival. A patient with a higher LAS is given a higher priority for transplant.

The LAS, implemented in 2005, was a vast improvement on the prior system, which allocated donor lungs based on the amount of time accrued by a patient on the waiting list rather than his or her risk of impending mortality while waiting. Over time, small changes were implemented to improve the accuracy of the LAS, but it was clear to this team of investigators that there was room for more comprehensive and systematic improvement.

Dr. Valapour and her colleague Jarrod Dalton, PhD, a data scientist at Cleveland Clinic's Lerner Research Institute, noted a major concern with the LAS system. It assumes that the relationship between clinical risk factors and mortality risk is fixed across all transplant candidates with end-stage lung disease. However, clinical observation clearly indicates that this is not the case.

Focus of the grant

With the award from the NIH, the team will work to develop a more dynamic system using microsimulations, a method that was not available when the LAS system was first developed.

This new system will incorporate day-to-day changes in candidates' pulmonary, cardiac, renal and other clinical measures, and determine how their interactions impact a patient's risk of mortality prior to and after transplant. This new system also will account for interactions between patients' race/ethnicity and neighborhood socioeconomic factors that may impact their survival — factors that are currently not part of the LAS. This group of researchers will work to simulate different donor lung allocation strategies to better understand how patient- and population-level outcomes will be impacted in this new system.

The team includes a transplant epidemiologist, statisticians, health economists and public policy experts and will involve collaboration with the U.S. Scientific Registry of Transplant Recipients (SRTR), the scientific arm of the U.S. transplant system funded by the Health Resources and Services Administration. Dr. Valapour serves as Senior Lung Transplant Investigator of SRTR and as a scientific advisor to U.S. lung transplant policymakers.

Potential impact of this work

With an average post-transplant life expectancy of 6.7 years, patients who have had lung transplant experience a shorter survival than patients with other solid organ transplants.

More accurately identifying those who may have the highest transplant benefit will provide for

rational changes to the current system to potentially maximize survival on the population level.

Other ongoing work in lung allocation

Improving the U.S. lung transplant allocation system is a major focus of research for this group, which has contributed to a number of recent changes. Two members of the team hold career development awards in this area. Wayne Tsuang, MD, MHS, holds an NIH K23 Career Development Award, studying the impact of broader geographic sharing of donor lungs on patient outcomes. Carli Lehr, MD, holds the Cystic Fibrosis Harry Shwachman Clinical Investigator Award, studying methods to improve timely transplant access for patients with cystic fibrosis.

Maryam Valapour, MD, MPP, is a lung transplant pulmonologist and Director of Lung Transplant Outcomes at Cleveland Clinic. She can be reached at valapom@ccf.org or 216.445.4071.

Wayne Tsuang, MD, MHS, is a lung transplant pulmonologist. He can be reached at tsuangw@ccf.org or 216.445.6448.

Carli Lehr, MD, is a lung transplant pulmonologist. She can be reached at lehrc@ccf.org or 216.444.0962.

Cleveland Clinic Completes Its 2,000th Lung Transplant

In July 2020, Cleveland Clinic's Lung and Heart-Lung Transplant Program completed its 2,000th lung transplant, a milestone that only two other lung transplant centers in the U.S. have reached to date.

Marie Budev, DO, Medical Director of the Lung and Heart-Lung Transplant Program and a pulmonologist/critical care physician in the Respiratory Institute, remarks that the program has had a reputation for high volume of patients and complexity of cases since its inception in 1990.

"The collaborative, team-based approach to the medical and surgical management of these complex patients has made our program a destination for patients from across the country and around the world," she says.

Performing more than 100 lung transplants annually, the program is considered one of the most active in the world, currently following more than 800 patients both in the pre- and post-transplant clinics. Patient survival rates exceed the national average at one and three years post-transplant.

Read more at **clevelandclinic.org/milestonesintransplantation**.

LUNG TRANSPLANTATION: BY THE NUMBERS

123
Lung transplants performed in 2019 — the third-highest volume in the U.S.

98
Bilateral

25
Single

25
Patients evaluated for lung transplantation in 2019

3-YEAR SURVIVAL RATES*

	Observed	Expected	National	Report dates
Graft survival	75.0%	71.2%	71.4%	1/1/2014-6/30/2016
Patient survival	76.5%	73.1%	73.3%	1/1/2014-6/30/2016

1-YEAR SURVIVAL RATES*

	Observed	Expected	National	Report dates
Graft survival	85.9%	88.9%	88.9%	7/1/2016-12/31/2018
Patient survival	98.6%	97.5%	97.7%	7/1/2016-12/31/2018

**From the most recent Scientific Registry of Transplant Recipients (SRTR) data release (1/7/20).*

METABOLIC DYSREGULATION IN PULMONARY ARTERIAL HYPERTENSION: BEYOND INSULIN RESISTANCE

By Gustavo Heresi, MD

KEY POINTS

A recent study used the hyperglycemic clamp technique to investigate pancreatic insulin secretion in individuals with idiopathic pulmonary arterial hypertension (PAH) and age-, BMI- and sex-matched controls.

Individuals with PAH had reduced circulating insulin levels in response to IV-induced hyperglycemia, but pancreatic insulin secretion was similar to that of controls.

Researchers also found that skeletal muscle in patients with PAH is more insulin sensitive compared with that of controls, contradicting the literature. In addition, fasting lipid and ketone metabolism was upregulated in PAH.

Findings suggest that rather than overt tissue insulin resistance in PAH, peripheral tissues in patients with PAH are insulin sensitive, but some factors are reducing the systemic insulin response to exogenous glucose.

Our group recently published a study that challenges the prevailing literature on insulin resistance in individuals with pulmonary arterial hypertension (PAH). These findings highlight the importance of metabolic research in PAH and should promote new lines of scientific inquiry in both pharmacological and dietary approaches for the treatment of PAH.

PAH is a rare yet deadly and under-recognized disease, characterized by remodeling of the pulmonary vascular bed, which leads to elevated pulmonary vascular resistance requiring progressive compensation by the right ventricle and culminating in right heart failure. Despite recent advances, prognosis remains poor, with estimated three-year survival rates of 55% to 69% in newly diagnosed patients.

Exploring the underlying pathophysiology

The pathobiology of PAH is incompletely understood, and none of the currently available treatments directly target the underlying pulmonary vascular remodeling or right heart dysfunction. As such, there remains a dire need to identify the underlying pathophysiology of PAH to improve disease management.

Recent literature suggests greater insulin resistance in individuals with PAH compared with healthy counterparts. However, these studies have primarily relied on static indices of insulin resistance (e.g., HOMA-IR) rather than dynamic measures from oral glucose tolerance tests (OGTTs) or intravenous glucose clamp procedures. Our group first conducted OGTTs in patients with PAH compared with age-, BMI- and sex-matched controls, verifying poor oral glucose tolerance in those with PAH, which coincided with reduced circulating insulin levels, suggesting a potential underlying issue of impaired pancreatic insulin secretion.[1]

A closer look: pancreatic insulin secretion in PAH

In the most recent study, we set out to investigate pancreatic insulin secretion using the gold-standard hyperglycemic clamp technique in individuals with idiopathic PAH and age-, BMI- and sex-matched controls.[2] Similar to our OGTT results, individuals with PAH had reduced circulating insulin levels in response to IV-induced hyperglycemia, but surprisingly, pancreatic insulin secretion was similar to that of controls. Our interrogation of other metabolic tissues involved in glucose and insulin regulation suggested the decrease in circulating insulin may instead be due to hepatic insulin extraction.

Surprisingly, we found that skeletal muscle in patients with PAH is more insulin sensitive compared with that of controls, contradicting the literature based on static measures of insulin resistance. In addition, fasting lipid and ketone metabolism is upregulated in PAH. We also conducted a larger-scale metabolomic analysis, mirroring our findings for fasted metabolism and the predominant upregulation of lipid and ketone metabolism. These metabolomics results provide additional confidence in the applicability

of this research to the greater population of individuals with PAH. The figure summarizes these findings.

Key takeaways and next steps

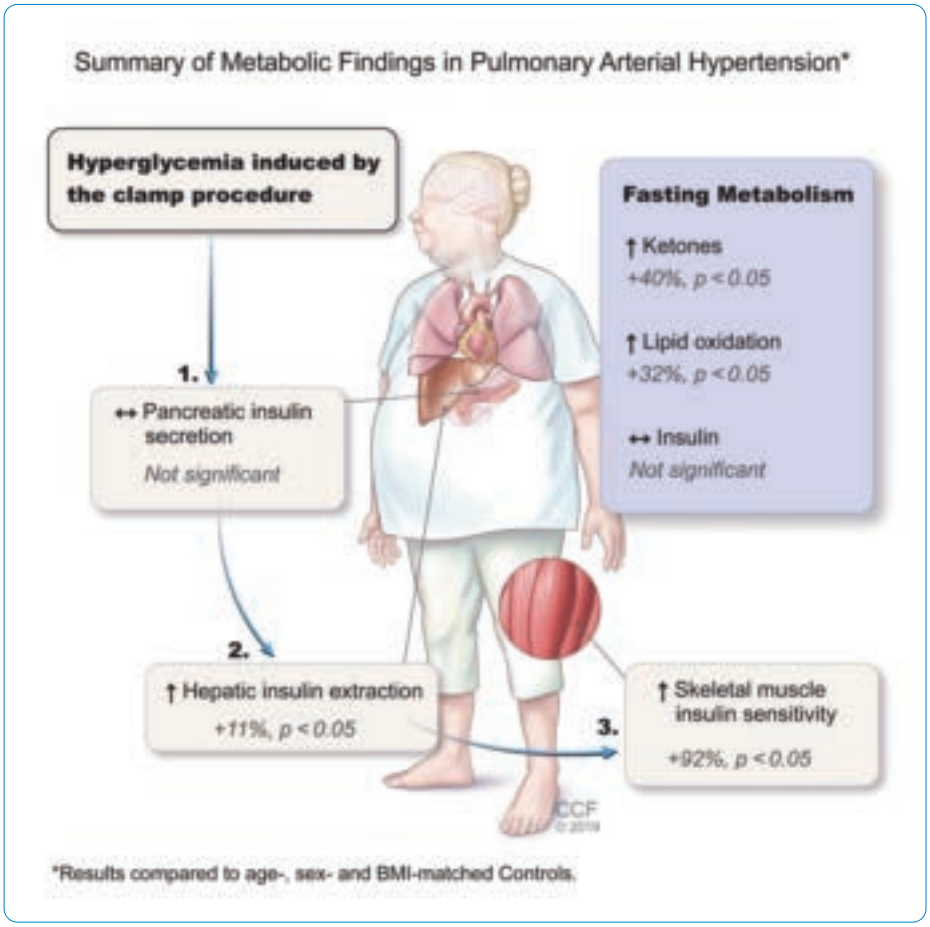
Taken together, our data suggest that rather than overt tissue insulin resistance in PAH, peripheral tissues in individuals with PAH are insulin sensitive, but some factors (potentially hepatic insulin extraction) are reducing the systemic insulin response to exogenous glucose (oral or intravenous). We hypothesize this may be due to the underlying PAH physiology, which prefers to utilize ketone and lipid metabolism at the expense of glucose control, perhaps to compensate for the progressive heart failure, as ketones are a more efficient fuel source.

The next step is to test pharmacologic or lifestyle approaches to minimize glucose excursions and/or promote ketone and lipid metabolism for improving clinical outcomes in PAH. Our group is currently investigating a lifestyle intervention, involving aerobic exercise (60 minutes/day, 5 days/week, 12 weeks) and the Mediterranean diet in individuals with PAH.

Gustavo Heresi, MD, is Director of the Pulmonary Vascular and Chronic Thromboembolic Pulmonary Hypertension Program in the Department of Pulmonary and Critical Care Medicine. His clinical and research interests include pulmonary hypertension, acute pulmonary embolism and chronic thromboembolic pulmonary hypertension (CTEPH). Tweet him @heresi_gustavo.

For inquiries related to this research, you can reach Dr. Heresi at 216.636.5327 or heresig@ccf.org.

FIGURE. Reproduced with permission of the © ERS 2020: *European Respiratory Journal* 2020 55: 1901700; DOI: 10.1183/13993003.01700-2019



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LIFE AFTER COVID-19: WHY THE POST-ICU RECOVERY CLINIC IS AN OPTION FOR SOME SURVIVORS

By Michelle Biehl, MD

KEY POINTS

Cleveland Clinic's Post-ICU Recovery Clinic (PIRC) provides better support for patients and families after a critical illness.

COVID-19 survivors are at an even higher risk for developing post-intensive care syndrome.

COVID-19 survivors who have been critically ill are offered follow-up appointments at the PIRC within two to four weeks after hospitalization.

The patients have a single visit during which they see an interdisciplinary team of healthcare providers, have their ICU course debriefed, have a thorough medication and vaccination review done by a pharmacist, and have a comprehensive physical evaluation. The patients' mental health is also evaluated.

Improvements in quality of care have resulted in a growing population of patients who survive critical illness each year. However, these intensive care unit (ICU) survivors frequently report a wide range of complications that may persist for months to years after their hospital discharge, calling attention to a need for extended support.

What is post-intensive care syndrome?

More than half of ICU survivors suffer from post-intensive care syndrome (PICS), which is new or worsening impairment in one or more of these domains: physical, cognitive function and mental health.[1] Physical impairment is quite prevalent (25%-80%)[2] and may include muscular weakness, fatigue, dyspnea, impaired pulmonary function, decreased exercise tolerance, sexual dysfunction, joint immobility, voice changes, dysphagia and respiratory failure, and can persist for up to five years.[3] Cognitive impairment is present in 30% to 80% of ICU survivors, varies in severity, and includes memory loss and difficulty with concentration, comprehension and critical thinking.[4]

Mental health impairment is also prevalent, occurring in 8% to 57% of cases and consisting of anxiety, depression and post-traumatic stress disorder (PTSD).[2] The major risk factors for the development of PICS are acute respiratory distress syndrome (ARDS), sepsis, delirium, prolonged mechanical ventilation and multiorgan failure.[5]

Studies on long-term outcomes of ICU survivors have also shown that one-quarter of patients require assistance with activities of daily living a year after ICU discharge, about one-third of patients do not go back to work and another one-third of patients do not go back to their pre-ICU job, resulting in financial constraints and causing significant impact not only on patients' lives but also on their family members' lives.[6] The mental health impairment that occurs in family members is known as PICS-Family.

Unfortunately, most of these impairments go undiagnosed or are inadequately treated due to multiple reasons, including a lack of awareness about PICS among providers. Patients, families, clinicians and healthcare systems share an interest in improving care for these patients.[7]

Several strategies have been used to decrease the prevalence of PICS, such as early mobility and post-acute care rehabilitation, reducing delirium, decreasing amounts of sedative medications, increasing involvement of families at the bedside, developing and debriefing ICU diaries, assessing nutrition, applying the ABCDEF bundle, providing early psychological intervention and cognitive therapy, and creating post-discharge follow-up programs.[8-10]

Cleveland Clinic's Post-ICU Recovery Clinic

To address this unmet clinical need, Cleveland Clinic's Post-ICU Recovery Clinic (PIRC) was created by a group of clinicians from the Respiratory Institute, with the goals of providing better support for patients and families after critical illness, improving transitions of care from inpatient to outpatient, decreasing readmission rates, improving morbidity and mortality rates, and

LEFT: More than half of ICU survivors suffer from post-intensive care syndrome, with a new or worsening impairment in their physical, cognitive and/or mental health.

ultimately promoting wellness, encouraging healing and supporting a return to the best state of recovery possible.

The PIRC comprises an interdisciplinary team that includes a critical care physician, advanced practice provider, pharmacist, psychiatrist, physical therapist, respiratory therapist and case manager. The course of the ICU stay is debriefed, and patients are evaluated for mental health, cognitive and physical impairments by obtaining a history and physical exam, as well as by applying screening tools that have been recommended as core outcome measures to evaluate ICU survivors after hospital discharge.[11]

Inclusion criteria for Cleveland Clinic's PIRC consist of shock, ARDS, delirium, cardiac arrest, prolonged mechanical ventilation (≥ 7 days), prolonged ICU stay (≥ 7 days) and COVID-19 patients with ICU length of stay ≥ 72 hours.

COVID-19 survivors are at higher risk for developing PICS

COVID-19, the disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), was declared a pandemic on March 11, 2020, by the World Health Organization. With over 11.7 million cases and more than 250,000 deaths in the United States (at the time of this publication), the pandemic likely will continue to have a great impact on patients, families and caregivers.

Patients with severe illness due to COVID-19 often develop critical illness with hypoxemic respiratory failure, most commonly ARDS, requiring ICU admission.[12] COVID-19 survivors are at an even higher risk for developing PICS given the prevalence of prolonged mechanical ventilation with exposure to a greater amount of sedatives, which commonly leads to a higher frequency of delirium; limited physical therapy during and after hospitalization due to the risk of disease transmission; scarcity of family support due to restricted visitation during hospitalization; and constraints on social support after hospitalization due to the stigma of the disease.[13]

Post-ICU care at rehabilitation centers, long-term acute care hospitals and skilled nursing facilities could be curtailed because of limited personal protective equipment, risk of transmission to caregivers and limited accessibility. During each patient's ICU stay, it is vital to utilize the daily ICU checklist and the ABCDEF bundle in order to mitigate the risk of PICS.[14] Optimization of nutrition and sleep quality is also key. Prior to hospital discharge, patients must be evaluated for the extent of physical, emotional and cognitive impairments, and effective treatment strategies must be initiated.

COVID-19 survivors who have been critically ill are offered follow-up appointments at the PIRC within two to four weeks after hospitalization. The patients can opt for telemedicine (virtual visit) or an in-person visit. Prior to the clinic visit, patients undergo a pulmonary function test and a six-minute walk distance test, and have a chest X-ray. Then in a single visit, patients see an interdisciplinary team of healthcare providers, have their ICU course debriefed, have a thorough medication and vaccination review done by a pharmacist, and have a comprehensive physical evaluation performed by physical therapy with a determination of whether further physical therapy is necessary.

Patients are also seen by our mental health team and are evaluated for mental health problems, such as anxiety, depression and PTSD, as well as cognitive impairment using the Montreal Cognitive Assessment. Pain, self-care, activities of daily living and quality of life are also evaluated.

Depending on their needs, patients may be referred to specialty centers such as those within the Neurological Institute for evaluation and treatment of cognitive deficits, to the Head & Neck Institute for evaluation of airway complications, or to nutrition and weight management programs, among others. A case manager is assigned to help patients navigate access to community resources and integrate recommendations. A summary of the clinic visit is sent to the patient's primary care physician to promote continuity of care.

The combination of passionate providers utilizing a holistic approach, the application of patient-centered screening tools and the resources that Cleveland Clinic offers, including access to top-notch specialty centers, makes the PIRC a great option for COVID-19 patients who survive critical illness to achieve the best state of recovery possible.

For more information or to refer a patient to the PIRC, call 216.445.6937 or email icurecovery@ccf.org.

PATIENT NEEDS REVEALED AT POST-ICU RECOVERY CLINIC VISITS

- Physical and occupational therapy
- Mental health support with referral to counseling, psychology or psychiatry
- Detailed cognitive evaluation with referral to comprehensive neurocognitive testing as needed
- Medication review and reconciliation, initiation, or discontinuation
- Education on respiratory treatments such as inhalers and nebulizers
- Prescriptions for durable medical equipment
- Coordination of home health services for patients with physical impairments
- Referrals to specialists
- Coordination of care among providers

Biehl M, Sese D. Post-intensive care syndrome and COVID-19 — Implications post pandemic. *Cleve Clin J Med.* 2020 Aug 5. Online ahead of print.

BELOW: Michelle Biehl, MD, Medical Director of the Post-ICU Recovery Clinic, leads a team to improve outcomes for patients with post-intensive care syndrome.

Michelle Biehl, MD, is a pulmonologist and intensivist at the Respiratory Institute and Medical Director of the Post-ICU Recovery Clinic (PIRC) at Cleveland Clinic. She has a special interest in ICU survivorship, ICU outcomes, patient-centered outcomes and humanizing the ICU. Contact her at 216.444.0350 or biehlm@ccf.org.

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FOOD ALLERGY CENTER OF EXCELLENCE OFFERS MULTIDISCIPLINARY CARE

KEY POINTS

Early peanut oral immunotherapy (EPOIT) is possible and has been effective in carefully selected young patients with peanut allergies at Cleveland Clinic's Food Allergy Center of Excellence (FACE).

EPOIT patients, all age 3 or younger, consume small quantities of peanut protein in gradually increasing doses. Patients develop tolerance, which they maintain with daily exposure to peanut protein.

The FACE provides comprehensive care for patients of all ages with food allergies. The team includes a psychologist and registered dietitians.

Oral immunotherapy drug Palforzia®, approved by the Food and Drug Administration (FDA) in early 2020, has changed the treatment landscape for children with peanut allergies — at least those ages 4-17. But children under age 4 also have oral immunotherapy options. Early peanut oral immunotherapy (EPOIT) is available and has been effective in carefully selected young patients with peanut allergies at Cleveland Clinic's Food Allergy Center of Excellence (FACE).

"We've had 30 kids participate to date," says Cleveland Clinic allergist and immunologist Sandra Hong, MD, Director of the FACE. "Two withdrew for unrelated reasons. Of the 28 remaining participants, with a combined total of more than 10,000 doses, only one child has required epinephrine. Nearly 70% of these patients currently are tolerating our maintenance dose of peanut protein, and the rest are continuing to build up to it."

EPOIT patients, all age 3 or younger, consume small quantities of peanut protein in gradually increasing doses. Over a series of weeks, patients develop tolerance, which they maintain indefinitely with daily exposure to approximately 500 mg of peanut protein, the equivalent of two peanuts.

"Conventionally, without EPOIT, we would have advised peanut avoidance and hoped for peanut tolerance to develop on its own," says Dr. Hong. "But only 20% of kids with a peanut allergy develop tolerance naturally. Assuming that statistic, most patients in our program likely never would have tolerated peanut exposure."

Approximately 80% of children with egg and milk allergies — which, with peanut, comprise the majority of food allergies in early childhood — develop tolerance naturally. Ingesting baked egg or baked milk in food can help children develop tolerance quicker, adds Dr. Hong. As such, peanut allergies remain a focus of the FACE. Tree nuts, soy, wheat, shellfish and finned fish round out the top eight allergens the FACE team addresses.

Care for allergy-induced anxiety and restricted diets

In addition to novel treatments like EPOIT, the FACE provides comprehensive care for patients of all ages with food allergies. The multidisciplinary team — the first of its kind in Northeast Ohio — includes a psychologist and registered dietitians.

"It's very common to see patients who have some level of anxiety about their food allergy and its treatments," says Cleveland Clinic psychologist Wendy Hahn, PsyD. "Most of their lives, they have had to think about what may happen if they eat something that may trigger a reaction, even when vigilant about monitoring. Some have had frightening experiences, being rushed to the emergency department, and many are fearful of injections and are scared to use their epinephrine auto-injector. When discussing treatments, like oral food challenges, patients have to manage the anxiety that comes with eating something they have previously been told not to eat."

Aside from the threat of allergic reactions, kids with food allergies often endure social stress, says Dr. Hahn. Children experience exclusion from parties and other activities because of their food

LEFT: Selected patients age 3 or younger with peanut allergies can be treated with early peanut oral immunotherapy at Cleveland Clinic's Food Allergy Center of Excellence.

risk. Research shows that the chance of being bullied increases with a food allergy diagnosis.

All patients at the FACE who report bullying are encouraged to meet with Dr. Hahn. So are families with older children receiving oral immunotherapy (OIT), including Palforzia.

"Kids and their families take on increased risk with OIT," says Dr. Hahn. "We work on decision-making for treatment, and techniques to handle the anxiety and fear of potential reactions."

Families also meet with a registered dietitian, who can individualize diet plans and recipes for the unique needs of those with food allergies.

"Dietitians review food labels and instruct families to target or avoid certain ingredients," says Dr. Hong. "They ensure kids with multiple food allergies are getting the nutrients they need while staying safe."

Leading the search for new therapies and better quality of life

Research efforts at the center are exploring new methods of treating and even preventing food allergies. For example, Cleveland Clinic allergist and immunologist Leigh Ann Kerns, MD, is a principal investigator in the international, multicenter EPITOPE study. EPITOPE is assessing the safety and efficacy of a peanut patch to induce desensitization in peanut-allergic children ages 1-3. Associate Director of the FACE Jaclyn Bjelac, MD, is the principal investigator of a clinical trial evaluating boiled peanut OIT in children ages 1-16.

To help schools prevent and be prepared for allergy emergencies, Cleveland Clinic allergist and immunologist Alice Hoyt, MD, has developed the Code Ana program. Dr. Hoyt provides local schools with prescriptions for stock epinephrine auto-injectors as well as training on how and when to use them.

"The mission of our center is to use the latest therapies, multidisciplinary care and leading research to treat patients with food allergies as well as improve their lives," says Dr. Hong.

Sandra Hong, MD, is Director of Cleveland Clinic's Food Allergy Center of Excellence (FACE). She can be contacted at hongs3@ccf.org or 440.878.2500.

Wendy Hahn, PsyD, is a pediatric psychologist at the FACE. She can be contacted at hahnw@ccf.org or 440.878.2500.

Leigh Ann Kerns, MD, is a pediatric allergist and immunologist. She can be contacted at kernsl2@ccf.org or 216.444.6340.

Jaclyn Bjelac, MD, is Associate Director of the FACE. She can be contacted at bjelacj2@ccf.org or 216.445.1449.

Alice Hoyt, MD, is an adult and pediatric allergist and immunologist. She can be reached at hoyta@ccf.org or 216.986.4000.

EDUCATION DAYS: A COMPLEMENT TO THE PULMONARY AND CRITICAL CARE FELLOWSHIP PROGRAM

KEY POINTS

In Cleveland Clinic's Pulmonary & Critical Care Medicine Fellowship Program, didactic teaching is consolidated into one day per month.

Each Education Day includes grand rounds with a visiting professor, interactive workshops, lectures from faculty and overviews of research initiatives, all centered on a specific theme.

Due to COVID-19, Education Days this academic year have been held virtually.

At any given time, trainees in Cleveland Clinic's three-year combined pulmonary and critical care fellowship program are delivering care across campus — whether they're staffing the bronchoscopy suite or another procedural area, managing outpatient and inpatient care, or responding to acute needs in the intensive care unit. Training also includes off-service and off-campus rotations, enabling trainees to develop working knowledge of other medical disciplines and gain Level 1 trauma center experience.

It's a robust and well-rounded model, but the nature of the experience makes it nearly impossible to expect a well-attended weekly lecture," says Rendell Ashton, MD, who has been Director of the Pulmonary & Critical Care Medicine Fellowship Program at Cleveland Clinic since 2010. "Further, the breadth of subspecialty concentrations within pulmonary and critical care medicine makes it essential to create clinical exposure opportunities for our trainees."

And that hasn't always been easy, according to Dr. Ashton. Several years ago, in response to these challenges, it became clear that in order to create a meaningful experience for fellows, leadership must engineer a day of learning dedicated to one topic and make it easy for all fellows to attend.

One day and one clinical theme

"We decided to consolidate didactic teaching into one day each month and organize the day around a clinical theme, like asthma or lung cancer, for example," explains Dr. Ashton. Each of these days has a faculty champion, specialty grand rounds with a visiting professor, interactive workshops, lectures from faculty in the discipline of the day, and overviews of basic, clinical and population-based research initiatives.

The interactive component enables fellows to get their hands on the equipment and have an interactive learning experience in a low-risk environment. For the bronchoscopy Education Day, the workshop included a session for fellows to perform a bronchial blocker placement on simulation models. For cystic fibrosis (CF) days, fellows practiced with oxygen-delivery equipment and mucus-clearance devices to better understand how the technology is used in the care of patients with CF.

The exposure to expertise in pulmonary and critical care complements the first-year fellow experience, which is designed to help trainees develop core competencies in diagnosing and managing pulmonary diseases and begin a customized career track. This continues in years two and three but with a heightened focus on exploring academic and leadership opportunities, developing mentored relationships, and applying those skills to a career in medicine. The fellows participate in monthly Education Days throughout their three-year training.

Education Day in the COVID-19 era

In late summer, the team regrouped for the first Education Day of the new academic year. The topic — chronic obstructive pulmonary disease —

LEFT: Cleveland Clinic's Pulmonary & Critical Care Medicine Fellowship Program, directed by Rendell Ashton, MD, has provided didactic lessons virtually due to COVID-19.

was not new in the rotation, but the format certainly was. While the COVID-19 pandemic altered the traditional structure of Education Day programming, feedback from the entirely virtual session remained largely positive, says Dr. Ashton, and was even preferred by some learners.

One thing that is unlikely to change is the Education Day program itself. Dr. Ashton, a pulmonary and critical care physician and longtime medical educator, knows how important it is to schedule dedicated learning time for trainees. In Cleveland Clinic's Respiratory Institute, this emphasis on education is a central feature. Without support from institute leadership as well as the faculty who cover the fellows' clinical duties one day each month, Education Day would not be possible.

He concludes, "Patient-centered care will always be the central tenet of our work, and education and training enables the highest possible level of care. In service of our patients, it's our responsibility to continue creating opportunities to train the next generation of physician leaders."

Rendell Ashton, MD, is a pulmonary and critical care medicine physician as well as Director of the Pulmonary & Critical Care Medicine Fellowship Program at Cleveland Clinic. He can be reached at ashtonr@ccf.org or 216.636.5321.

RESPIRATORY INSTITUTE ACTS AS A SYSTEMWIDE UNIT IN RESPONSE TO THE COVID-19 PANDEMIC

By Abhijit Duggal, MD, and Raed Dweik, MD, MBA

KEY POINTS

In anticipation of an increase in critically ill patients during the COVID-19 pandemic, the Respiratory Institute developed a surge plan, coordinating its network of intensive care units (ICUs) throughout Northeast Ohio.

During crisis conditions, Cleveland Clinic's ICU capacity could be expanded by 900% to 1,053 beds throughout the region.

Critical care could be provided in nontraditional locations, such as in the emergency department and procedural areas.

Plans for increasing the number of available mechanical ventilators included reallocation of anesthesia machines as ICU ventilators and adapting single ventilators to split the airflow circuit.

Cleveland Clinic has 11 regional hospitals throughout Northeast Ohio, with capacity of more than 500 intensive care unit (ICU) beds. As home to pulmonary medicine, critical care and infectious disease departments, Cleveland Clinic's Respiratory Institute coordinated this expansive network of regional ICUs and was able to design an innovative structure integrating these units for optimal resource allocation in anticipation of a surge in volume of critically ill patients during the COVID-19 pandemic.

Development of a surge plan

The initial step for the surge plan included assessing the ability of the health system to augment capacity based on local needs across the geographic and temporal expanse of the surge. Without changing the current staffing model, the medical ICU (MICU) at Cleveland Clinic's main campus included a total capacity of 85 beds, with ample mechanical ventilators and supplies. In addition, the entire regional network could accommodate 520 ICU patients under normal conditions. Inventories of staffing, space and supplies were compared with epidemiological predictions for the pandemic, including possible worst-case scenarios developed by Respiratory Institute experts and other groups.

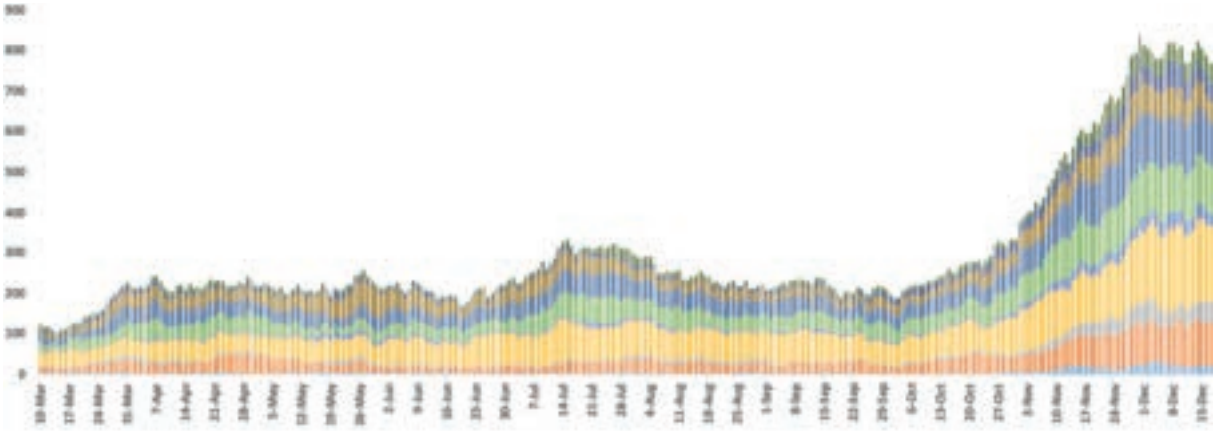
The ability to rapidly expand bed capacity and mobilize resources within the hospital system allows Cleveland Clinic to immediately adapt to increased patient loads associated with disasters. The Respiratory Institute developed its own model for tiered surge capacity using four designations: conventional, extension of capacity, contingency and crisis. At main campus, these designations would allow expansion of ICU capacity by 0%, 20%, 100% and 200% respectively, taking into consideration the inventory of resources, including staffing, space and supplies.

By combining and coordinating ICU resources throughout the region, the "contingency" capacity could be expanded to 520 beds, an increase of over 500% compared with the "conventional" main campus MICU. For "crisis" levels of care, adding repurposed areas capable of providing critical care, including post-anesthesia units and nonmedical units and procedure areas with monitoring capability and high-flow oxygen outlets, the overall capacity could be expanded by 900% to 1,053 beds throughout the region.

Standardized management of critically ill patients with COVID-19

Institutional protocols for caring for patients with COVID-19 were developed and disseminated throughout the health system by multidisciplinary teams of critical care and infectious disease physicians, advanced practice providers, nurses, respiratory therapists and pharmacists.

Physicians, nurses and respiratory therapists from main campus, who routinely manage the most complex and critically ill patients in the hospital system, were systematically redeployed to smaller regional hospitals, where there was less experience performing certain aspects of critical care management. These assignments brought knowledge and confidence in applying infrequently used skills, such as prone positioning of patients in severe hypoxic respiratory failure.



LEFT: Midnight census of COVID-19 patients by date, color-coded by Cleveland Clinic hospital, March 10-Dec. 15, 2020

Under the guidance of physicians from the Respiratory Institute, educational modules were developed and disseminated through Cleveland Clinic's MyLearning platform. They addressed general topics in critical care, specifically aimed at noncritical care providers who might be redeployed during surge staffing scenarios.

Repurposing of patient care areas

During surge conditions requiring "contingency" and "crisis" responses, elective procedures could be canceled to reduce ICU use. Additionally, critical care could be provided in nontraditional locations, such as in the emergency department and procedural areas.

Nonclinical spaces also could be converted into temporary hospital bed spaces for lower-acuity patients. For example, Cleveland Clinic's Health Education Campus was converted into a temporary hospital with a capacity of approximately 1,000 beds, complete with newly installed oxygen and suction capability for each bed space.

Extending responsibilities

There were several strategies for increasing the workforce for "contingency" and "crisis" care. For example, changes in usual workflow could include increasing work hours or nurse-to-patient ratios during surge conditions.

Non-ICU clinicians also could help extend the capacity of ICU providers. Cleveland Clinic dedicated significant resources to educating and preparing noncritical care providers in the event that they needed to be reassigned to critical care units. This initiative included having nurses from bronchoscopy and other procedural areas shadow ICU nurses, integrating fellows from noncritical care specialties with ICU teams, and credentialing subspecialty fellows to work as internal medicine hospitalists.

Conservation, adaptation and substitution of supplies

Pandemic-related patient surges would strain the availability of technology and other supplies. Plans for increasing the number of available mechanical ventilators included reallocation of anesthesia machines as ICU ventilators and adapting a single ventilator for simultaneous use by more than one patient by using valves and fittings to split the airflow circuit. Daily inventory was taken of all ventilators and related supplies, and ventilators throughout the system were reallocated based on current and anticipated needs, guided by a committee of experts in critical care and respiratory therapy.

At the onset of the pandemic, Cleveland Clinic took a careful inventory of its personal protective equipment (PPE), including N95 masks, surgical masks, disposable gloves and gowns. There was a stockpile of N95 masks that would last a year during typical use. In accordance with guidelines from the Centers for Disease Control and Prevention, efforts were made to conserve N95 masks by restricting their use to procedures with the highest risk of aerosolization, such as BiPAP use, bronchoscopy and endotracheal intubation. Protocols also were developed for the safe reuse of some PPE in appropriate situations.

Abhijit Duggal, MD, is a specialist in critical care medicine. He can be reached at duggala2@ccf.org or 216.444.4838.

Raed Dweik, MD, MBA, is Chair of the Respiratory Institute. He can be reached at dweikr@ccf.org or 216.445.5763.

SELECTED CLINICAL STUDIES

Consider offering your patients enrollment in a leading-edge clinical research trial at our Respiratory Institute. Contact the study coordinator or principal investigator for more information.

COPD

Roflumilast or azithromycin to prevent COPD exacerbations (RELIANCE)

Principal Investigator: Umur Hatipoglu, MD
Study Coordinator: Rick Rice, RRT | 216.444.1150

A randomized, double-blind, placebo-controlled, parallel-group, 52-week pivotal study to assess the efficacy, safety and tolerability of dupilumab in patients with moderate-to-severe chronic obstructive pulmonary disease (COPD) – (BOREAS)

Principal Investigator: Umur Hatipoglu, MD
Study Coordinator: Rick Rice, RRT | 216.444.1150

A sham controlled prospective randomized clinical trial of the RejuvenAir® system for the treatment of moderate to severe chronic obstructive pulmonary disease with chronic bronchitis (SPRAY-CB)

Principal Investigator: Thomas Gildea, MD
Study Coordinator: Yvonne Meli, RN, BC, CCRP | 216.445.4215

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CRITICAL CARE MEDICINE

Crystalloid liberal or vasopressors early resuscitation in sepsis (CLOVERS)

Principal Investigator: Abhijit Duggal, MD
Study Coordinator: Alexander King | 216.445.3960

A prospective, multicenter, randomized, controlled, pivotal trial to validate the safety and efficacy of the Hemolung® Respiratory Assist System for COPD patients experiencing an acute exacerbation requiring ventilatory support (VENT-AVOID)

Principal Investigator: Abhijit Duggal, MD
Study Coordinator: Alexander King | 216.445.3960

A protocol comparing temporary transvenous diaphragm pacing to standard of care for weaning from mechanical ventilation in ICU patients (RESCUE 3)

Principal Investigator: Tarik Hanane, MD
Study Coordinator: Bryan Poynter | 216.445.1630

Bacteremia antibiotic length actually needed for clinical effectiveness: a randomized controlled trial (BALANCE)

Principal Investigator: Abhijit Duggal, MD
Study Coordinator: Bryan Poynter | 216.445.1630

Cooling to help injured lungs (CHILL) phase IIb randomized control trial of therapeutic hypothermia in patients with ARDS

Principal Investigators: Abhijit Duggal, MD; Rachel Scheraga, MD
Study Coordinator: Omar Mehkri | 216.445.1939

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CYSTIC FIBROSIS

Cystic Fibrosis Foundation Patient Registry

Principal Investigator: Elliott Dasenbrook, MD
Study Coordinator: David Weaver, BSN, CCRC | 216.445.6671

Cystic Fibrosis Lung Transplant Consortium

Principal Investigator: Maryam Valapour, MD
Study Coordinator: David Weaver, BSN, CCRC | 216.445.6671

Prospective study of peripherally inserted venous catheters in CF patients — the PICC-CF study

Principal Investigator: Elliott Dasenbrook, MD
Study Coordinator: David Weaver, BSN, CCRC | 216.445.6671

A protocol to test the impact of discontinuing chronic therapies in people with cystic fibrosis on highly effective CFTR modulator therapy (SIMPLIFY)

Principal Investigator: Elliott Dasenbrook, MD
Study Coordinator: David Weaver, BSN, CCRC | 216.445.6671

A phase 4 study to compare U.S.-marketed Creon® drug product with drug product manufactured with a modernized process at an alternate manufacturing site, in subjects with EPI due to cystic fibrosis

Principal Investigator: Elliott Dasenbrook, MD
Study Coordinator: David Weaver, BSN, CCRC | 216.445.6671

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INFECTIOUS DISEASE

Prospective observational study of human immunodeficiency virus (HIV)-positive deceased donor renal transplantation for HIV-positive recipients

Principal Investigator: Christine Koval, MD
Study Coordinator: Kiran Ashok | 216.445.6744

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INTERSTITIAL LUNG DISEASE

A phase 3, randomized, double-blind, parallel-group, placebo-controlled multicenter study to evaluate the efficacy and safety of two doses of GLPG1690 in addition to local standard of care for minimum 52 weeks in subjects with idiopathic pulmonary fibrosis (ISABELA)

Principal Investigator: Leslie Tolle, MD
Study Coordinator: Ron Wehrmann, RRT | 216.445.0574

A randomized, double-blind, multicenter, parallel, placebo-controlled phase 2b study in subjects with idiopathic pulmonary fibrosis (IPF) investigating the efficacy and safety of TD139, an inhaled galectin-3 inhibitor administered via a dry powder inhaler over 52 weeks (GALACTIC-1)

Principal Investigator: Aman Pande, MD
Study Coordinator: Ron Wehrmann, RRT | 216.445.0574

Chronic fibrosing interstitial lung disease with progressive phenotype prospective outcomes (ILD-PRO) registry

Principal Investigator: Daniel Culver, DO
Study Coordinator: Sue Gole, RRT | 216.445.5836

A phase I, double-blind, placebo-controlled, single and multiple inhaled dose, safety, tolerability, and pharmacokinetic study of TRK-250 in subjects with idiopathic pulmonary fibrosis

Principal Investigator: Daniel Culver, DO
Study Coordinator: Ron Wehrmann, RRT | 216.445.0574

A multicenter, randomized, double-blind, placebo-controlled, phase 2 study of the efficacy and the safety and tolerability of BMS-986278 in participants with pulmonary fibrosis

Principal Investigator: Daniel Culver, DO
Study Coordinator: Sue Gole, RRT | 216.445.5836

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LUNG CANCER

DECAMP 1 PLUS proposal: prediction of lung cancer using noninvasive biomarkers

Principal Investigator: Peter Mazzone, MD
Study Coordinator: Stuart Houltham | 216.444.1056

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LUNG TRANSPLANT

Improving frailty with a rigorous ambulation intervention in lung transplant patients (iFRAIL)

Principal Investigator: Marie Budev, DO, MPH
Study Coordinator: Abigail Camiener | 216.444.8347

A phase III, prospective, multicenter, randomized, controlled clinical trial to demonstrate the effectiveness and safety of liposomal cyclosporine A (L-CsA) inhalation solution delivered via the PARI investigational eFlow® device plus standard of care versus standard of care alone in the treatment of bronchiolitis obliterans syndrome in patients post lung transplantation (BOSTON-1 and BOSTON-2)

Principal Investigator: Marie Budev, DO, MPH
Study Coordinator: Valerie Shaner, RRT | 216.444.3766

An open-label, single-arm, phase 1/2 study evaluating the safety and efficacy of itacitinib in participants with bronchiolitis obliterans syndrome following lung transplantation

Principal Investigator: Marie Budev, DO, MPH
Study Coordinator: JoAnne Baran-Smiley, BSN, RN | 216.444.5023

Cleveland Clinic Lung Transplant Biorepository

Principal Investigator: Maryam Valapour, MD
Study Coordinator: David Weaver, BSN, CCRC | 216.445.6671

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PULMONARY HYPERTENSION

Pulmonary Hypertension Research Registry

Principal Investigator: Kristin Highland, MD
Study Coordinator: Mary Beukemann | 216.444.2140

Study evaluating the efficacy and safety of ralinepag to improve treatment outcomes in PAH patients (ADVANCE Outcomes)

Principal Investigator: Alice Goyanes, MD
Study Coordinator: Mary Beukemann | 216.444.2140

Pulmonary arterial hypertension improvement with nutrition and exercise (PHINE) — a randomized controlled trial

Principal Investigator: Gustavo Heresi, MD
Study Coordinators: Chazity Bush | 216.444.3702
Celia Melillo | 216.445.3763

A phase 3, randomized, placebo-controlled, double-blind, adaptive study to evaluate the safety and efficacy of inhaled treprostinil in

patients with pulmonary hypertension due to chronic obstructive pulmonary disease (PH-COPD) – (PERFECT)

Principal Investigator: Joseph Parambil, MD
Study Coordinator: Mary Beukemann | 216.444.2140

Selexipag in inoperable or persistent/recurrent chronic thromboembolic pulmonary hypertension (SELECT)

Principal Investigator: Gustavo Heresi, MD
Study Coordinator: Julia Ashton | 216.445.7075

A phase 1b, randomized, subject- and investigator-blinded, placebo-controlled, multicenter clinical trial to evaluate the safety, pharmacokinetics, pharmacodynamics, and biomarkers of inhaled GB002 in subjects with WHO Group 1 pulmonary arterial hypertension (PAH)

Principal Investigator: Kristin Highland, MD
Study Coordinator: Julia Ashton | 216.445.7075

A multicenter, randomized, double-blind, placebo-controlled study in participants with sarcoidosis-associated pulmonary hypertension (SAPH) to assess the efficacy and safety of oral selexipag

Principal Investigator: Joseph Parambil, MD
Study Coordinators: Mary Beukemann | 216.444.2140
Allison Wimer, RRT | 216.445.9557

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RARE LUNG DISEASES

ALPHA-1 ANTITRYPSIN DEFICIENCY

Alvelestat (MPH996) for the treatment of alpha-1 antitrypsin deficiency (ATALANTa)

Principal Investigators: Umur Hatipoglu, MD; James Stoller, MD
Study Coordinator: Rick Rice, RRT | 216.444.1150

BRONCHIECTASIS

Clinical effectiveness of high frequency chest wall oscillation (HFCWO) in a bronchiectasis population

Principal Investigator: Elliott Dasenbrook, MD
Study Coordinator: Valerie Shaner, RRT | 216.444.3766

ARISE — a randomized, double-blind, placebo-controlled, active comparator, multicenter study to validate patient-reported outcome instruments in adult subjects with newly diagnosed nontuberculous mycobacterial (NTM) lung infection caused by *Mycobacterium avium* complex (MAC)

Principal Investigator: Elliott Dasenbrook, MD
Study Coordinator: Valerie Shaner, RRT | 216.444.3766

ENCORE — a randomized, double-blind, placebo-controlled, active comparator, multicenter study to evaluate the efficacy and safety of an amikacin liposome inhalation suspension (ALIS)-based regimen in adult subjects with newly diagnosed nontuberculous mycobacterial (NTM) lung infection caused by *Mycobacterium avium* complex (MAC)

Principal Investigator: Elliott Dasenbrook, MD
Study Coordinator: Valerie Shaner, RRT | 216.444.3766

PULMONARY ALVEOLAR PROTEINOSIS

A randomized, double-blind, placebo-controlled clinical trial of once-daily inhaled molgramostim nebulizer solution in adult subjects with autoimmune pulmonary alveolar proteinosis (aPAP)

Principal Investigator: Daniel Culver, DO
Study Coordinator: Sue Gole, RRT | 216.445.5836

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SARCOIDOSIS

Acthar® gel for cutaneous sarcoidosis

Principal Investigator: Daniel Culver, DO
Study Coordinator: JoAnne Baran-Smiley, BSN, RN | 216.444.5023

A phase 4 multicenter, randomized, double-blind, placebo-controlled pilot study to assess the efficacy and safety of H.P. Acthar gel in subjects with pulmonary sarcoidosis

Principal Investigator: Debasis Sahoo, MD
Study Coordinator: Allison Wimer, RRT | 216.445.9557

Routine cardiac screening in sarcoidosis patients (PAPLAND)

Principal Investigator: Daniel Culver, DO
Study Coordinator: Allison Wimer, RRT | 216.445.9557

A randomized, double-blind, placebo-controlled multiple ascending dose study of intravenous ATYR1923, novel molecular entity that acts as an extracellular immunomodulator, in patients with pulmonary sarcoidosis

Principal Investigator: Daniel Culver, DO
Study Coordinator: Allison Wimer, RRT | 216.445.9557

Prospective registry of outcomes in myocardial sarcoidosis (PROMyS)

Principal Investigator: Manual Ribeiro, MD
Study Coordinator: Allison Wimer, RRT | 216.445.9557

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AN ENABLING PHILANTHROPIC GIFT: CELEBRATING 10 YEARS OF THE PATRICIA L. AND THOMAS P. BRUNDIGE BRONCHOSCOPY SUITE

The Patricia L. and Thomas P. Brundige Bronchoscopy Suite saw its first patients in August 2010. This was a five-year planning and construction project based on a large donation in memory of Thomas Brundige in recognition of the care provided by Atul C. Mehta, MD. At inception, the suite was the most technologically advanced of its kind. It was equipped with leading-edge technology and staffed with teams of caregivers dedicated to delivering diagnostic and therapeutic interventions for our increasing bronchoscopy volumes. We assembled a team of teams with anesthesia, nursing, respiratory therapy and pathology professionals, including advanced practitioners, pulmonary and critical care physicians, and several technicians.

Delivering care for patients, training the next generation of physicians

The suite is home to multiple clinical services, including several bronchoscopy service lines, a pleural disease service line and now a percutaneous tracheostomy service with supporting outpatient practices. Clinically, we have performed tens of thousands of procedures, and we have cared for people from all over the world. In fact, around 30% of our patients travel from outside of Ohio for our care. We have also been part of several miraculous clinical events, including witnessing the unexpected birth of two children in the bronchoscopy area.

The suite also houses the Interventional Pulmonary Fellowship Program, the only advanced fellowship in the Respiratory Institute. The program has helped further establish the specialty, with members who have contributed their expertise by defining board eligibility and writing many of the questions that appear on board examinations. It is also the primary work area of the largest and highest-volume interventional pulmonology program in the U.S., with seven board-certified interventional pulmonologists.

Past and future: a model for research and innovation

Over the past 10 years, we have advanced the field through our work in lobar stenting; several advanced peripheral biopsy technologies, including early studies with robotic bronchoscopy; and mobile

multidimensional imaging. We continue to be integral to clinical research for the treatments of emphysema, asthma, lung cancer, interstitial lung disease and lung transplant. We performed the first in-human work for developing patient-specific airway stents using 3D-printing technology, which are now approved by the Food and Drug Administration and moving to commercialization. We have published over 140 articles in the past 10 years, advancing knowledge to improve care of people all over the world. We don't just follow the standard of care; we advance and define it.

Cleveland Clinic's bronchoscopy program is the model on which the future of bronchoscopy and interventional bronchoscopy will be built. We have trained a generation of pulmonologists and interventional pulmonologists who are now leading international programs in Chile and Abu Dhabi and at renowned U.S. centers, like Stanford and Massachusetts General Hospital. We have even published about the design and construction of our suite as the blueprint for all bronchoscopy suites.[1]

As we close the books on the first 10 years of the bronchoscopy program, we marvel at our success and reflect on the challenges ahead. We look to the future to expand, reinvent and reimagine what we can do to build on the foundation of this most generous gift made in service to our patients.

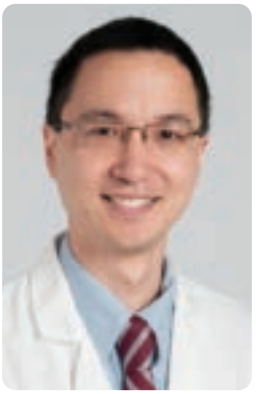
Contributed by Thomas R. Gildea, MDMS, FCCP

REFERENCE

1. Mehta AC, Avasarala SK, Jain P, Deshwal H, Gildea TR. A blueprint for success: design and implementation of an ideal bronchoscopy suite. *Chest.* 2020;157(3):712-723.


Rachel Scheraga, MD


Brian Southern, MD


Wayne Tsuang, MD, MHS


Joe Zein, MD, PhD


Gustavo Heresi, MD, MS

THE NATIONAL INSTITUTES OF HEALTH HONORS 5 PULMONOLOGISTS WITH K AWARDS

The National Institutes of Health awards grants to scientists and institutions advancing the biomedical research priorities of the United States. K awards are five-year, highly selective research grants that enable faculty to establish impactful and innovative research programs. The Respiratory Institute, in collaboration with the Lerner Research Institute, supports five such physician-scientists who use basic, translational, clinical and population science methods to advance our nation's understanding and care of respiratory diseases.

Rachel Scheraga, MD: My research seeks to discover mechano-sensitive pathophysiologic mechanisms of acute respiratory distress syndrome. The goal of my program going forward is to identify molecular targets to ameliorate immune dysfunction in the lung during injury.

Brian Southern, MD: My research focus is on what drives the progression of idiopathic pulmonary fibrosis (IPF). My team has discovered several key proteins in fibroblasts that are involved in mechanosensing (transduction of mechanical signals like lung stiffness), which may lead to novel therapeutic targets to halt the progression of fibrosis.

Wayne Tsuang, MD, MHS: My research is focused on improving lung transplant outcomes because worldwide post-transplant survival has averaged only five years, half the survival of a liver or heart transplant recipient. My team uses large data registries in a multidisciplinary approach to understand the cumulative effects of transplant policy, social determinants of health and health disparities on patient outcomes.

Joe Zein, MD, PhD: My research is focused on gender differences in asthma, and the role sex hormones play in asthma and severe asthma. The goal of my program going forward is to identify new biomarkers and develop new knowledge that will help implement sex-based precision care in asthma.

Gustavo Heresi, MD, MS: My research focus is on metabolic abnormalities in pulmonary vascular disease. We have discovered extensive abnormalities in glucose, insulin and lipid metabolism in patients with pulmonary arterial hypertension. Our current work seeks to modify these abnormalities to improve clinical outcomes.


Daniel Culver, DO

NEW CHAIR OF PULMONARY MEDICINE

Daniel Culver, DO, has been appointed the new Chair of Pulmonary Medicine in Cleveland Clinic's Respiratory Institute.

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ABOUT CLEVELAND CLINIC

Cleveland Clinic is a nonprofit, multispecialty academic medical center integrating outpatient and hospital care with research and education for better patient outcomes and experience. More than 4,500 staff physicians and researchers provide services through 20 patient-centered institutes. Cleveland Clinic is a 6,026-bed healthcare system with a main campus in Cleveland, 18 hospitals and over 220 outpatient locations. The health system includes five hospitals in Southeast Florida with more than 1,000 beds, a medical center for brain health in Las Vegas, a sports and executive health center in Toronto and a 364-bed hospital in Abu Dhabi. Cleveland Clinic London, a 184-bed hospital, will open in 2022. Cleveland Clinic is currently ranked as one of the nation's top hospitals by *U.S. News & World Report*.

clevelandclinic.org

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