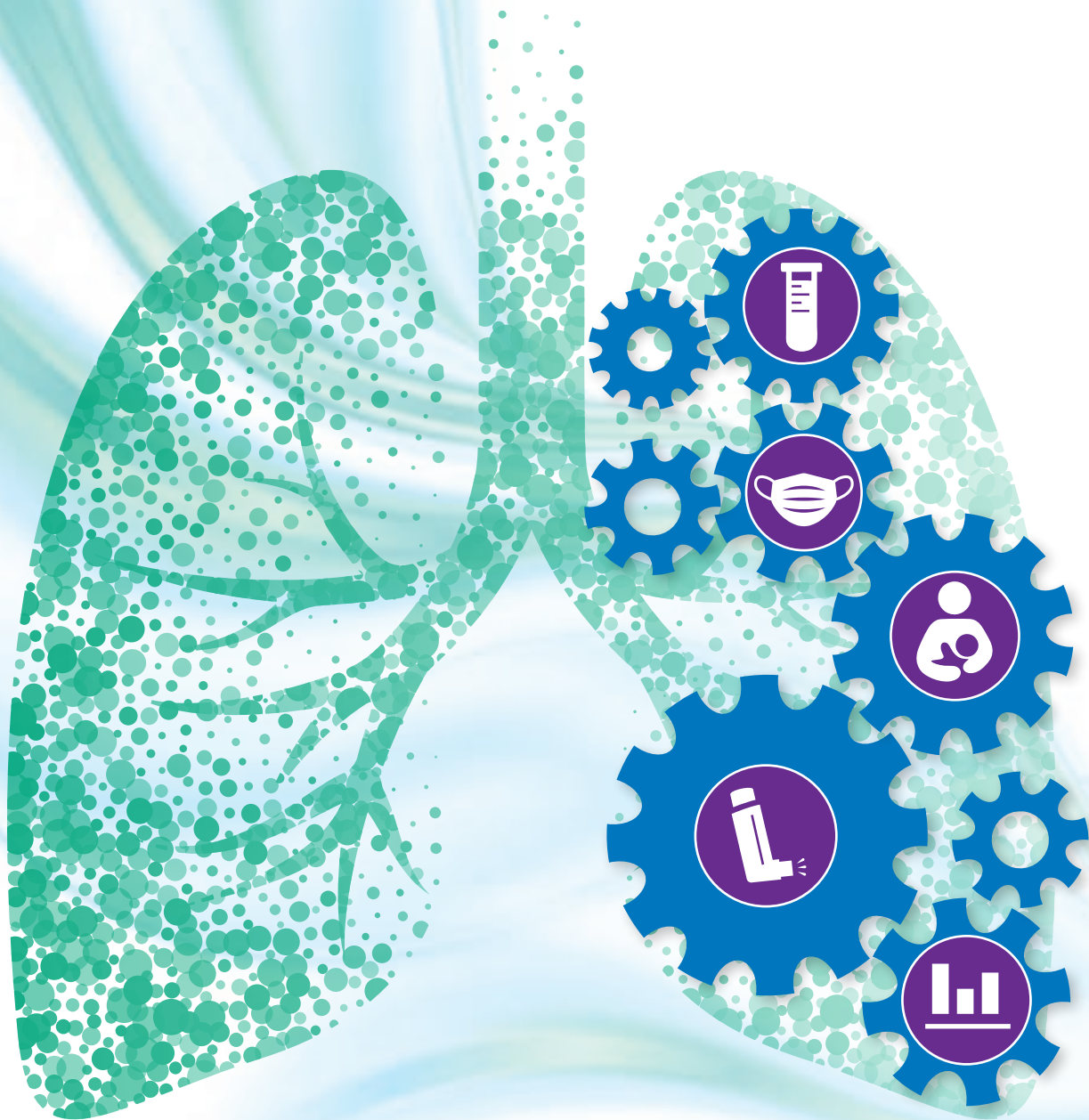


A SUPPLEMENT TO CHEST PHYSICIAN

# PULMONOLOGY

## DATA TRENDS 2023



 **CHEST** Physician<sup>®</sup>

Produced in collaboration  
with **CHEST**

September 2023

# BREATHE EASY WHEN DIAGNOSING RESPIRATORY INFECTIONS.



©2023 bioMérieux, Inc. • BIOMÉRIEUX, the BIOMÉRIEUX logo, PIONEERING DIAGNOSTICS, BIOFIRE, FILMARRAY, and VIDAS are used pending and/or registered trademarks belonging to bioMérieux or one of its subsidiaries, or one of its companies. • B-R-A-H-M-S PCT is the property of Thermo Fisher Scientific, Inc. and its subsidiaries • Patents: www.biomérieux.usa.com/patents • PRN 060164 Rev01.1A

Results from our respiratory solutions provide clarity, enabling clinicians to know earlier, intervene sooner, and improve patient outcomes.



SCAN ME



**BIOFIRE®  
RESPIRATORY 2.1 PANEL**

**1 Test. 22 Targets. ~45 Minutes.**

FDA cleared |

**Sample Type: Nasopharyngeal swab**

Identifies 22 of the most common respiratory viruses and bacteria.



**BIOFIRE® FILMARRAY®  
PNEUMONIA PANEL**

**1 Test. 33 Targets. ~1 Hour.**

FDA cleared | CE<sub>2797</sub>

**Sample Type: BAL-like (including mini-BAL)  
Sputum-like (including ETA)**

Identifies 26 of the most common respiratory viruses and bacteria, and 7 antimicrobial resistance genes.



**VIDAS® B-R-A-H-M-S PCT™**

**1 Test. ~20 Minutes.**

FDA cleared

**Sample Type: Serum or plasma**

Measures procalcitonin (PCT), a specific marker of severe bacterial infection in patients with lower respiratory tract infections.

Product availability varies by country. Consult your bioMérieux representative.

**CHEST**

**Editor in Chief,  
CHEST Physician**  
Angel Coz, MD, FCCP

**Publisher, CHEST**  
Nicki Augustyn, CAE

**Senior Director,  
Communications and Publishing**  
Susan Rice, MSEd

**Director, Content Strategy  
and Operations**  
Heather Watkins

**Managing Editor, News Channels**  
Rebecca Barshop

**Manager, Editorial Resources**  
Pamela L. Goorsky

The American College of Chest Physicians ("CHEST") and its officers, regents, executive committee members, members, related entities, employees, representatives, and other agents (collectively, "CHEST Parties") are not responsible in any capacity for, do not warrant and expressly disclaim all liability for, any content whatsoever in any CHEST publication or other product (in any medium) and the use or reliance on any such content, all such responsibility being solely that of the authors or the advertisers, as the case may be. By way of example, without limiting the foregoing, this disclaimer of liability applies to the accuracy, completeness, effectiveness, quality, appearance, ideas, or products, as the case may be, or of resulting from any statements, references, articles, positions, claimed diagnosis, claimed possible treatments, services, or advertising, express or implied, contained in any CHEST publication or other product. Furthermore, the content should not be considered medical advice and is not intended to replace consultation with a qualified medical professional. Under no circumstances, including negligence, shall any CHEST Parties be liable for any DIRECT, INDIRECT, INCIDENTAL, SPECIAL or CONSEQUENTIAL DAMAGES, or LOST PROFITS that result from any of the foregoing, regardless of legal theory and whether or not claimant was advised of the possibility of such damages. The authors, editors, and publisher have exerted every effort to ensure that drug selection and dosage set forth in this text are in accordance with current recommendations and practice at the time of publication. However, in view of ongoing research, changes in government regulations, and the constant flow of information relating to drug therapy and drug reactions, the reader is urged to check the package insert for each drug for any change in indications and dosage and for added warnings and precautions. This is particularly important when the recommended agent is a new or an infrequently employed drug. Some drugs and medical devices presented in this publication may have US Food and Drug Administration (FDA) clearance for limited use in restricted research settings. It is the responsibility of the health-care provider to ascertain the FDA status of each drug or device planned for use in his or her clinical practice. Neither the editors of CHEST<sup>®</sup> Physician nor the Editorial Advisory Board nor the reporting staff contributed to this content. Copyright © 2023 by the American College of Chest Physicians<sup>®</sup>. All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means—electronic, mechanical, photocopied, recorded, otherwise—without the prior written permission of the copyright owner.



**Frontline Medical  
Communications  
Society Partners**

**Director, MDedge News**  
Kathy Scarbeck, MA

**Executive Editor**  
Kerry Hanisch

**Editorial Directors**  
Madeline Bailey, MS  
JT Keitt  
Stephanie Pelczar

**Creative Director**  
Louise A. Koenig

**Designer**  
Melissa L. Watkins

**Senior Production Manager**  
Maria Aquino

**Director, Business Development**  
John Molluso, 201-232-5567  
jmolluso@mdedge.com

**Frontline Medical  
Communications  
Corporate**

283 - 299 Market St.  
(2 Gateway Building),  
4th Floor  
Newark, NJ 07102  
Tel: 973-206-3434  
Fax: 973-206-9378

**VP, Sales**  
Mike Guire

**VP, Partnerships,  
Products, Strategy**  
Amy Nadel

**Circulation Director**  
Jared Sonners

# TABLE OF CONTENTS

- 4 Contributing Authors
- 6 Long-Awaited RSV Vaccines Now Available for Older Adults and Pediatric Patients  
**Burton L. Lesnick, MD, FCCP**
- 8 Decreasing Pulmonary Embolism-Related Mortality  
**Parth Rali, MD**
- 12 Addressing Physician Burnout in Pulmonology and Critical Care  
**Kelly Vranas, MD, MCR**
- 14 Updated Guidelines for COPD Management: 2023 GOLD Strategy Report  
**Muhammad Adrish, MD, MBA, FCCP, FCCM**
- 16 Progressive Pulmonary Fibrosis: Understanding Its Many Forms  
**Tejaswini Kulkarni, MD, MPH, FCCP**
- 18 Sleep Apnea: Comorbidities, Racial Disparities, Weight Guidelines, and Alternatives to CPAP  
**Lauren Tobias, MD, FCCP**
- 21 Lung Cancer Screening: A Need for Adjunctive Testing  
**Eric S. Edell, MD, FCCP**
- 23 Asthma Across a Woman's Lifespan  
**Navitha Ramesh, MD, FCCP**
- 26 Tuberculosis Management: Returning to Pre-Pandemic Priorities  
**Patricio Escalante, MD, MSc, FCCP, and Paige K. Marty, MD**
- 28 Long COVID: Advocating for Patients and Implementing Effective Techniques  
**Kyle B. Enfield, MD, MS, FSHEA, FCCM**
- 30 References

# PULMONOLOGY

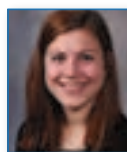
## DATA TRENDS 2023

## Contributing Authors

The staff at CHEST and the editors of *Pulmonology Data Trends 2023* and *CHEST Physician* would like to thank the following experts for their contributions to this issue.



**Muhammad Adrish, MD, MBA, FCCP, FCCM**  
Associate Professor  
Section of Pulmonary and Critical Care Medicine  
Department of Medicine  
Baylor College of Medicine  
Ben Taub Hospital  
Houston, TX



**Paige K. Marty, MD**  
Fellow  
Division of Pulmonary and  
Critical Care Medicine  
Mayo Clinic  
Rochester, MN



**Burton L. Lesnick, MD, FCCP**  
Pediatric Pulmonologist  
Children's Healthcare of Atlanta  
Atlanta, GA



**Parth Rali, MD**  
Associate Professor  
Temple University Hospital  
Philadelphia, PA



**Eric S. Edell, MD, FCCP**  
Internist and Pulmonologist  
Mayo Clinic  
Rochester, MN



**Navitha Ramesh, MD, FCCP**  
Program Director  
UPMC Harrisburg  
Harrisburg, PA



**Kyle B. Enfield, MD, MS, FSHEA, FCCM**  
Associate Professor of Medicine  
Vice Chair, Quality Improvement and Patient Safety  
University of Virginia;  
Associate Chief Medical Officer, Critical Care  
Department of Medicine  
University of Virginia Health System  
Charlottesville, VA



**Lauren Tobias, MD, FCCP**  
Assistant Professor  
Department of Pulmonary, Critical Care  
& Sleep Medicine  
Yale University School of Medicine;  
Medical Director  
Sleep Program  
VA Connecticut  
Yale-New Haven Hospital  
New Haven, CT



**Patricio Escalante, MD, MSc, FCCP**  
Professor of Medicine and Consultant  
Division of Pulmonary, Critical Care Medicine,  
and Sleep Medicine  
Mayo Clinic  
Rochester, MN



**Kelly Vranas, MD, MCR**  
Assistant Professor of Medicine  
Division of Pulmonary, Allergy, and  
Critical Care Medicine  
Oregon Health & Science University;  
Critical Care Health Services Researcher  
Portland VA Medical Center  
Portland, OR



**Tejaswini Kulkarni, MD, MPH, FCCP**  
Associate Professor of Medicine  
Director, Interstitial Lung Disease Program  
Division of Pulmonary, Allergy and  
Critical Care Medicine  
The University of Alabama at Birmingham  
Birmingham, AL



# Minimal Practice Changes, Major Patient Impact

Experience and patient feedback tell us patients are more compliant and have better outcomes when they feel understood. Getting to know your patients in the short window of time you have is challenging. Try these free, self-paced learning modules designed to help you nurture connections faster and more meaningfully.



### **Building Patient Trust Fundamentals**

Quickly create rapport, respond with empathy, and build your relationship.

### **Building Patient Trust Skills Practice**

Apply your empathetic communication skills by conversing with a simulated patient.

The First 5 Minutes® program consists of evidence-based skills to establish trust with your patients in the first 5 minutes of your interactions. With improved communication, you'll see that it takes less effort to help your patients more.



**Get Started**

*CHEST gratefully acknowledges the following supporters of the First 5 Minutes: Founding Supporters - Amgen, AstraZeneca, Bexar County, Boehringer Ingelheim, Novartis, Regeneron, Sanofi, and VIATRIS. Trailblazer Supporter - GSK*

# Long-Awaited RSV Vaccines Now Available for Older Adults and Pediatric Patients

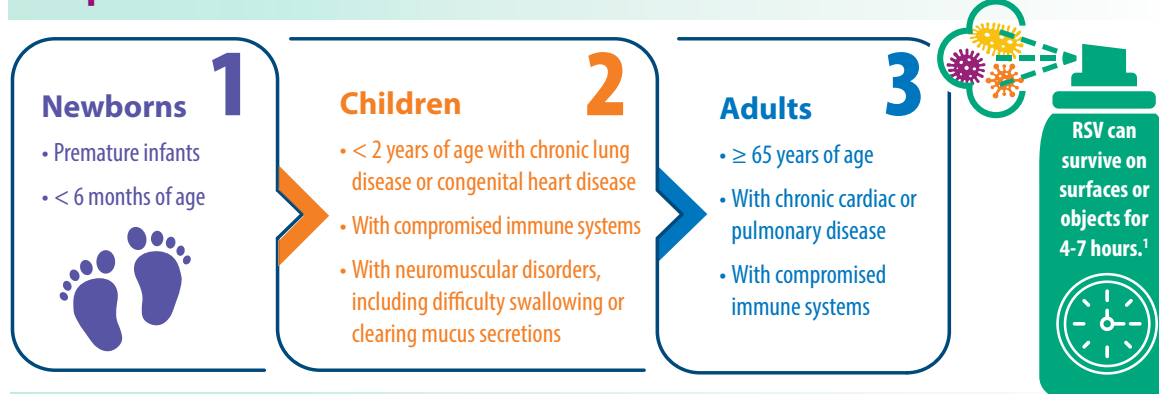
Burton L. Lesnick, MD, FCCP

Respiratory syncytial virus (RSV) is highly contagious and transmitted by large aerosol droplets and fomites, either emitted from an infected person or by making surface-to-eye, -nose, or -mouth contact.<sup>1</sup> Severe RSV can increase the risk of bacterial coinfections, pneumonia, and lower respiratory tract infections (LRTI)—particularly in infants and older adults.<sup>2</sup>

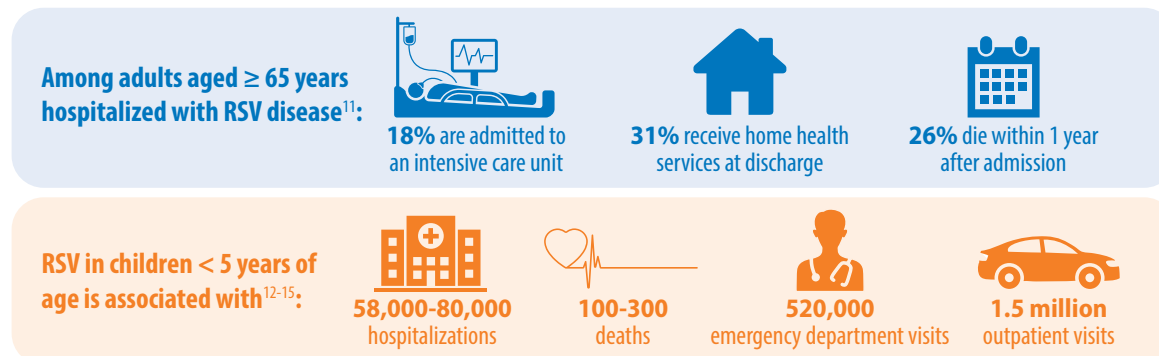
Thankfully, 2023 has been a landmark year for RSV approvals. The FDA approved its first RSV vaccine, called RSV prefusion F protein based (RSVpreF) vaccine, for people aged 60 and over in May 2023.<sup>3</sup> In July 2023, the passive monoclonal antibody injection nirsevimab was approved as a preventative option for infants in their first and second winter seasons.<sup>4</sup> Finally, the FDA approved the RSVpreF vaccine for pregnant individuals in late August 2023, with the goal of protecting infants.<sup>5</sup> However, results from a recent phase 3 trial did not show significance with respect to the primary end point.<sup>6</sup>

Birth through 6 months is the leading timeframe of RSV-related death because of the low natural defenses and small airways of infants. On August 3, 2023, the CDC Advisory Committee on Immunization Practices unanimously recommended use of nirsevimab for all infants up to 8 months of age at the start of the RSV season and for infants at risk for severe RSV infection until 19 months of age.<sup>7</sup> This decision was partly based on the MELODY and MEDLEY trials.<sup>8</sup> In an unprecedented move, this monoclonal antibody will be made available through the Vaccines For Children program, the first monoclonal antibody to receive this designation. It is hoped that uptake of this therapy will result in fewer hospitalizations of infants with RSV bronchiolitis.

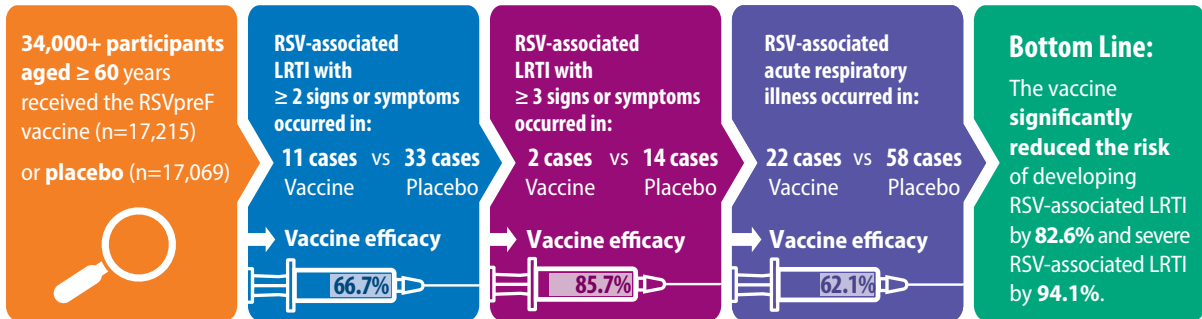
## Populations at Greatest Risk for Severe Illness From RSV<sup>9,10</sup>



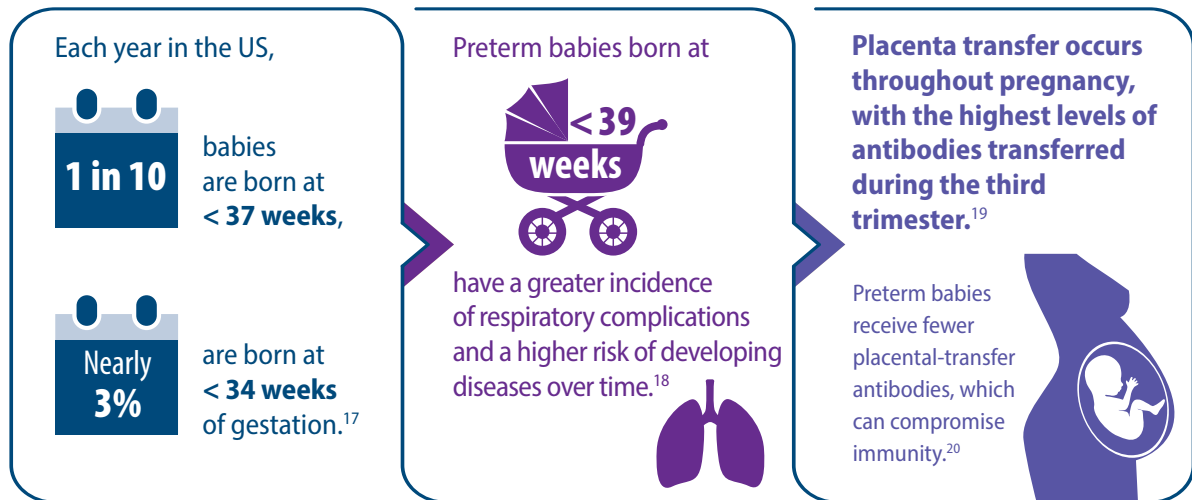
## Annual RSV Burden in the United States<sup>11-15</sup>



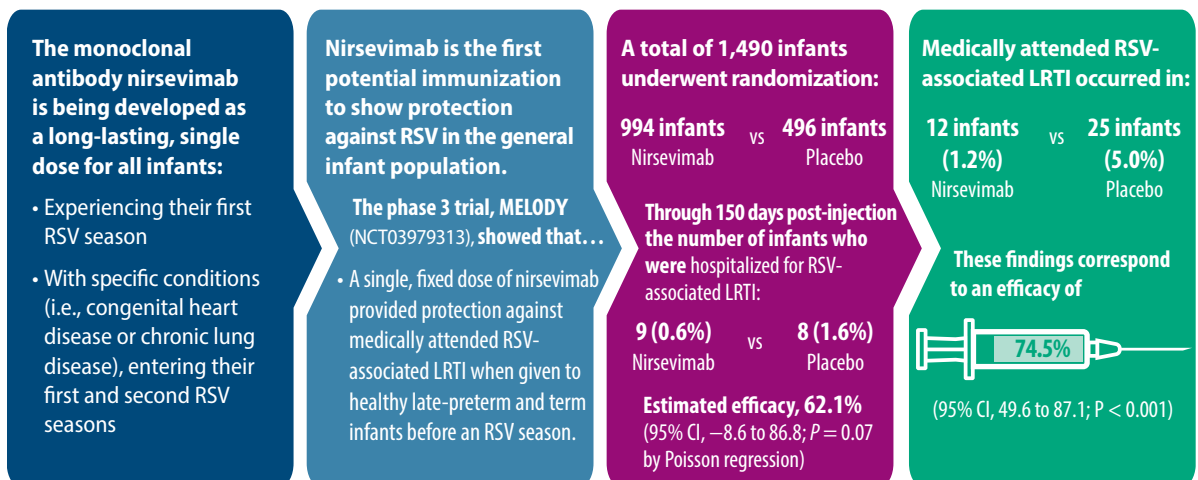
## The Phase 3 RENOIR Study<sup>16</sup>



## Preterm Babies and the Need for Protection<sup>17-20</sup>



## The Monoclonal Antibody Nirsevimab<sup>8</sup>



The current anti-RSV antibody, Synagis, is limited only to high-risk infants, and it provides 1-month of protection—requiring 5 injections for a full RSV season.<sup>21</sup>

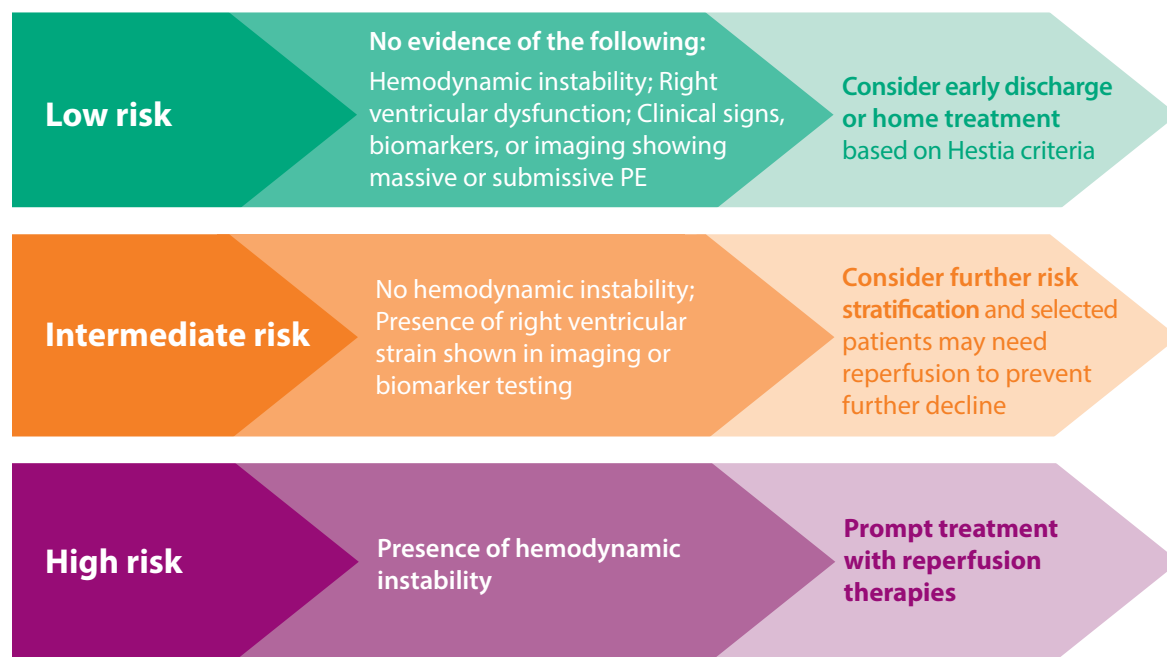
# Decreasing Pulmonary Embolism-Related Mortality

Parth Rali, MD

As many as 900,000 patients have deep vein thrombosis (DVT) or pulmonary embolism (PE), also called venous thromboembolism (VTE), each year in the United States, with 100,000 deaths per year.<sup>1</sup> In patients with PE, 56% also have DVT, which can affect 30-day mortality rates.<sup>2</sup> The field of PE is evolving to help decrease mortality from these events. Proper risk stratification is crucial to identify the best approach for each patient, while the presence of comorbidities and unmodifiable risk factors must also be considered when individualizing care and assessing likelihood of mortality.<sup>3,4</sup> As comorbidities increase, mortality increases in PE.<sup>4</sup> As well, racial, ethnic, and socioeconomic demographic differences affect PE, with Black patients having greater PE severity and socioeconomically underserved patients having higher follow-up mortality.<sup>5,6</sup>

Treatments are also advancing, with many upcoming catheter-based treatments in clinical trials, which have demonstrated rapid recovery of right ventricle function—a primary cause of PE-related mortality.<sup>7,8</sup> The effect of catheter-based treatment on long-term functional outcomes is currently being explored in clinical trials. Artificial intelligence is also being used to aid in diagnosis and treatment.<sup>9</sup> As the armamentarium of treatment options diversifies, so must our overall approach to management. The PE response team (PERT) strategy uses a multidisciplinary team of experts to further individualize patient care to help decrease mortality and improve follow-up efforts since the post-PE period is a sensitive time for new morbidity.<sup>10,11</sup> With proven risk stratification and management strategies available and new treatments on the way, the field of PE looks to improve not only in patient acute mortality, but also long-term functional outcomes, and early detection of post-PE comorbid conditions.

## PE Risk Stratification Method<sup>3</sup>





## Racial, Ethnic, and Socioeconomic Risk Factors in PE<sup>5,6,12,13</sup>

### Ethnicity

Hispanic/Latino patients have **lower rates of high-risk PE** vs non-Hispanic patients

Hispanic/Latino patients **19%**

Non-Hispanic/Latino patients **25%**

yet similar rates of inpatient mortality

**6.8%**

**7.5%**

### Race

Black patients present with PE at a younger age



and with higher severity than White patients

### Socioeconomic

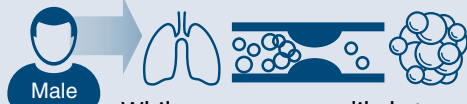
Nearly 1 in 3 patients from low socioeconomic backgrounds are readmitted within 90 days of discharge after a PE hospitalization.



### Sex



Women are more likely to have **varicose veins, depression, prolonged immobility, or a history of hormonal therapy...**



While men are more likely to have **atherosclerotic diseases, lung disease, cancer, or unprovoked PE.**

## PERT Approach to Decrease Mortality<sup>10,14</sup>

### Step 1

Evaluation and diagnosis



### Step 2

Risk stratification



### Step 3

Multidisciplinary intervention

Can include pulmonary, critical care, emergency medicine, cardiac surgery, radiology, cardiology, clinical pharmacy, vascular surgery

### Step 4

Management measures based on risk level



### Step 5

Assessment of treatment and follow-up (2 weeks to 3 months)



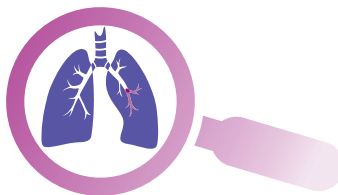
## PE Clinical Trials on the Horizon<sup>15-22</sup>

The field of PE is adapting catheter-based treatments in acute PE treatments. These treatments aim to have similar efficacy to systemic thrombolytics with less bleeding risk.<sup>8</sup> The following are selected trials that are ongoing and enrolling patients, and hope to generate more scientific evidence in PE treatment landscape.

Trial	Drug or Catheter Type	Primary Endpoint
<b>PE-TRACT</b> (RCT, N = 500)	Anticoagulant therapy vs catheter-directed therapy	3 months: Peak O <sub>2</sub> consumption on CPET 12 months: NYHA classification 7 days: Major bleeding
<b>PEERLESS</b> (RCT, N = 550)	Catheter-directed thrombolysis vs FlowTrieve System	Composite end point of all-cause mortality, or intracranial hemorrhage, major bleeding, clinical deterioration, or ICU admission
<b>PEERLESS II</b> (RCT, N = 1,200)	FlowTrieve System vs anticoagulation only	Composite end point of all-cause mortality, or intracranial hemorrhage, major bleeding, clinical deterioration, or ICU admission
<b>HI-PEITHO</b> (RCT, N = 406)	Anticoagulation with heparin vs EkoSonic™ Endovascular System	PE-related mortality, PE recurrence, or cardiorespiratory collapse
<b>STORM-PE</b> (RCT, N = 600)	Anticoagulation vs mechanical aspiration thrombectomy	Change in right ventricle and left ventricle ratio; Post-PE functional outcomes
<b>PEITHO-3</b> (RCT, N = 650)	Alteplase vs anticoagulation only	Death from any cause, hemodynamic decompensation, recurrent PE
<b>STRIKE-PE</b> (N = 600)	Indigo Aspiration System	Change in right ventricle and left ventricle ratio and composite score of major adverse events; Post-PE functional outcomes
<b>RESCUE<sup>a</sup></b> (N = 109)	The Bashir Endovascular Catheter + r-tPA	Change in right ventricle and left ventricle ratio

CPET, cardiopulmonary exercise testing; ICU, intensive care unit; NYHA, New York Heart Association; PE, pulmonary embolism; RCT, randomized clinical trial; r-tPA, recombinant tissue plasminogen activator

<sup>a</sup>Final results from RESCUE (NCT04248868) posted in April 2023.





**IN BRONCHIECTASIS,**  
NEUTROPHILIC INFLAMMATION  
CAN BE A **DAMAGING FORCE**

Neutrophils and neutrophil serine proteases normally help protect the lungs from harm, but in bronchiectasis they can contribute to inflammation and lung destruction.<sup>1-6</sup>



Learn more about inflammation in bronchiectasis at [RethinkNCFBE.com](https://RethinkNCFBE.com)

Visit Insmmed's bronchiectasis **Booth #1001** at the CHEST Annual Meeting 2023 in Hawaii

**References:** 1. Flume PA, et al. *Lancet*. 2018;392(10150):880-890. 2. Dente FL, et al. *Mediators Inflamm*. 2015;2015:642503. 3. Effah CY, et al. *Front Immunol*. 2021;12:689866. 4. Rosales C. *J Leukoc Biol*. 2020;108(1):377-396. 5. Keir HR, Chalmers JD. *Semin Respir Crit Care Med*. 2021;42(4):499-512. 6. Chalmers JD, et al. *Am J Respir Crit Care Med*. 2017;195(10):1384-1393.



© 2023 Insmmed Incorporated. All Rights Reserved. Insmmed is a trademark of Insmmed Incorporated. All other trademarks are property of their respective owner. NP-BE-US-00198 07/2023

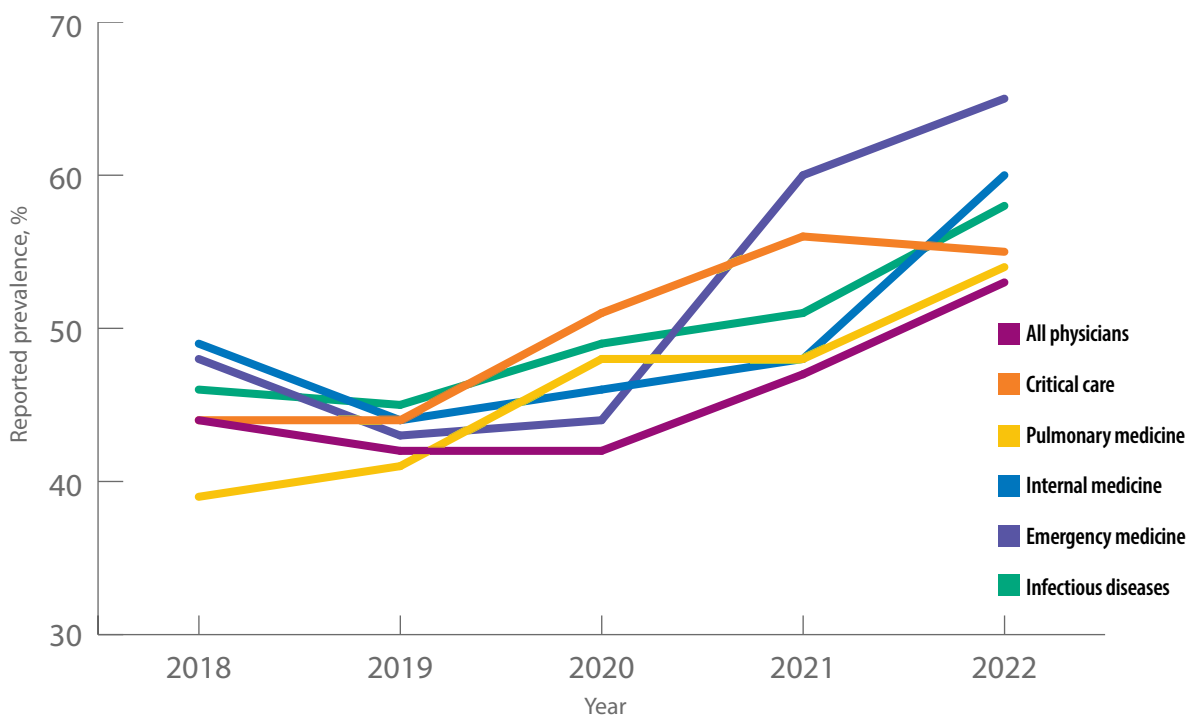
# Addressing Physician Burnout in Pulmonology and Critical Care

Kelly Vranas, MD, MCR

Work-related stress has long been a concern for those working in the intensive care unit (ICU); even before the COVID-19 pandemic, it was estimated that up to 45% of critical care physicians had at least one symptom of severe burnout.<sup>1-6</sup> In 2020 and the years following, the combination of significantly increased patient morbidity and mortality rates, excessive workloads, and resource limitations negatively impacted employee morale, decreased feelings of professional fulfillment, increased moral distress, and most importantly, heightened mental health concerns among critical care physicians.<sup>7-10</sup>

While most of the post-pandemic world has returned to “normal,” its effect on the health care industry has been slower to wane; in fact, reported rates of physician burnout remain higher today than they were in 2020.<sup>2-6</sup> Almost half of physicians (49%) say their depression affects their patient interactions, while 65% report that their personal relationships are affected.<sup>6</sup> In order to course-correct—not only for the sake of our current workforce and patients, but also to ensure better preparation for future public health crises—we must address the more fundamental burnout contributors that the pandemic only amplified.

## Reported Rates of US Physician Burnout<sup>2-6,a</sup>

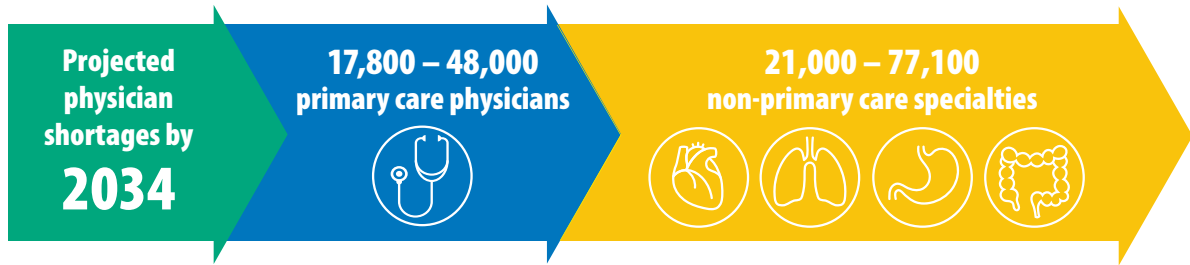


<sup>a</sup>Based on annual surveys of approximately 9,100 – 15,000 physicians across 29 specialties in total.

Common manifestations of burnout<sup>2</sup>



## Combating Physician Burnout and Impending Shortages<sup>11</sup>



To mitigate the number of health care professionals leaving practice, some changes must be made:

### Protect health care workers<sup>7</sup>

**8 in 10**

report physical or verbal abuse at work

### Free up physicians' time<sup>7,12,13</sup>

**2 hours** vs **1 hour**

> 50% of pulmonologists and intensivists say having too many administrative tasks adds to their burnout

### Increase mental health care access<sup>12,13</sup>

**16%** vs **11%**

**Pulmonologists** vs **Intensivists**

have sought professional help to reduce their burnout

### Improve physician resources<sup>7,8,12,13</sup>

- ✓ Training
- ✓ Equipment access
- ✓ Feedback forums

29% of pulmonologists and intensivists agree that **lack of control/autonomy** contributes to their burnout

### Build morale and engagement<sup>6,7,11-13</sup>

**37%** vs **58%**

**Pulmonologists** vs **Intensivists**

say that lack of respect from employers, colleagues, and other staff contributes to their burnout

Key components for building a sense of community among clinicians:

- ✓ Support
- ✓ Camaraderie
- ✓ Mentorship
- ✓ Activism

# Updated Guidelines for COPD Management: 2023 GOLD Strategy Report

Muhammad Adrish, MD, MBA, FCCP, FCCM

The Global Initiative for Chronic Obstructive Lung Disease (GOLD) Strategy Report is an evidence-based strategy document for chronic obstructive pulmonary disease (COPD) diagnosis, treatment, and prevention; the GOLD report is used worldwide as a tool for implementing effective COPD management.<sup>1</sup> The annual report reviews the major research publications published from the previous years and provides important updated recommendations for care providers.

The 2023 GOLD report includes several new updates, such as a new proposed definition<sup>2</sup>; strategies for terminology and taxonomy<sup>2</sup>; etiotypes for COPD<sup>2</sup>; screening and risk factor updates<sup>1</sup>; and vaccination recommendations.<sup>1</sup> The ABCD Assessment Tool has been revised to recognize the clinical relevance of exacerbations,<sup>3</sup> and the section on Interventional and Surgical Therapies for COPD has been expanded.<sup>1</sup> Information on imaging and computed tomography (CT) has been included,<sup>1</sup> and issues related to inhaled delivery<sup>4</sup> and adherence<sup>5</sup> have been addressed. Also included is an expanded role of triple inhaled therapy in select patient populations,<sup>6</sup> and the complexity of COPD is also examined—which involves not only cigarette smoking, but other exposures as well.<sup>7</sup>

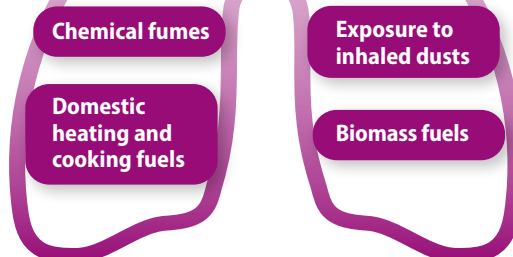
## Key Changes in the 2023 GOLD Report<sup>2,3,8-10</sup>

### Proposed New Definition of COPD<sup>2</sup>:

*“COPD is a heterogeneous lung condition characterized by chronic respiratory symptoms (dyspnea, cough, expectoration) due to persistent abnormalities of the airways (bronchitis, bronchiolitis), alveoli (emphysema), and/or pulmonary vessels, confirmed by spirometrically determined airflow limitation and/or objective evidence of structural or physiological pulmonary dysfunction.”*

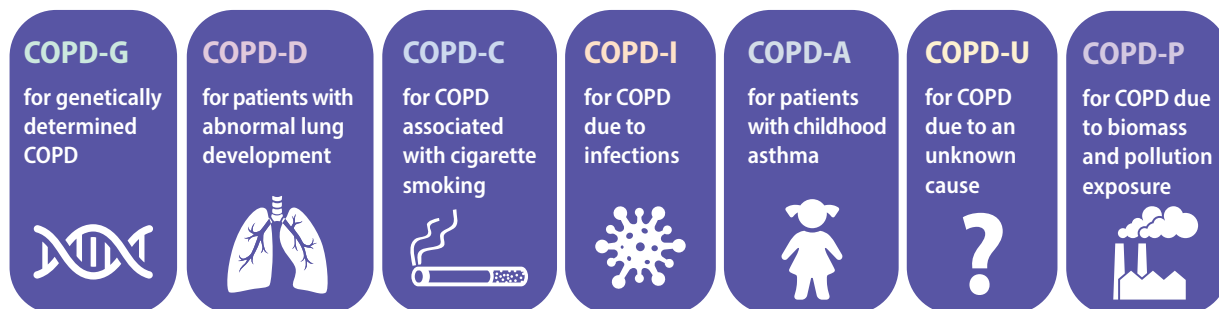
### New Section: Chronic Bronchitis<sup>8</sup>

Chronic bronchitis can also be found in never-smokers, suggesting the involvement of other factors, such as:



**COPD can be caused by** several factors unrelated to smoking. The GOLD report attempts to address this heterogeneity by proposing the following etiotypes for COPD.

### New Proposed Taxonomy (etiotypes) for COPD<sup>2</sup>



## Updated COPD Assessment Tool<sup>3</sup>

The ABCD patient assessment tool is now called the **ABE Assessment Tool**:

<p><b>Group A</b></p> <ul style="list-style-type: none"> <li>✓ mMRC dyspnea scale score of 0-1</li> <li>✓ CAT score &lt; 10</li> <li>✓ History of 0-1 moderate exacerbation not leading to hospitalization</li> </ul>	<p><b>Group B</b></p> <ul style="list-style-type: none"> <li>✓ mMRC score ≥ 2</li> <li>✓ CAT score ≥ 10</li> <li>✓ History of 0-1 moderate exacerbation not leading to hospitalization</li> </ul>
<p><b>Groups C and D</b></p> <p><i>have been merged into a single group E to highlight the clinical relevance of exacerbations. This proposal will need validation in appropriate clinical trials.</i></p>	<p><b>Group E</b></p> <p>History of ≥ 2 moderate exacerbations or ≥ 1 exacerbation leading to hospitalization, irrespective of mMRC or CAT scores</p>

CAT, COPD Assessment Test; mMRC, modified Medical Research Council

## Updated COPD Assessment Tool<sup>3</sup>

When initiating treatment with long-acting bronchodilators, the preferred choice is a combination of a LAMA and a LABA.

The use of a LABA-ICS combination should not be encouraged in patients with COPD. When ICS use is indicated, the recommendation is to use LABA + LAMA + ICS combination because of its superiority over LABA + ICS.

ICS should be used in patients with COPD who have features of asthma.

The algorithm also recommends considering LABA + LAMA + ICS for patients in group E if blood eosinophil counts are ≥ 300 cells per  $\mu$ L.

ICS, inhaled corticosteroid; LABA, long-acting  $\beta$ 2-agonist; LAMA, long-acting muscarinic agent

## COPD Exacerbation Definition Update<sup>9</sup>

*“An event characterized by increased dyspnea and/or cough and sputum that worsen over  $\leq$  14 days, which may be accompanied by tachypnea and/or tachycardia and is often associated with increased local and systemic inflammation caused by airway infection, pollution, or other insult to the airways.”*

## COPD and Comorbidities<sup>1,10</sup>

COPD often coexists with other diseases that may have a clinically significant impact on prognosis:

- Cardiovascular disease
- Obstructive sleep apnea
- Periodontitis
- Metabolic syndrome, diabetes
- Gastroesophageal reflux disease
- Osteoporosis or frailty
- Anemia
- Polycythemia
- Anxiety, depression
- Lung cancer
- Bronchiectasis
- Cognitive impairment

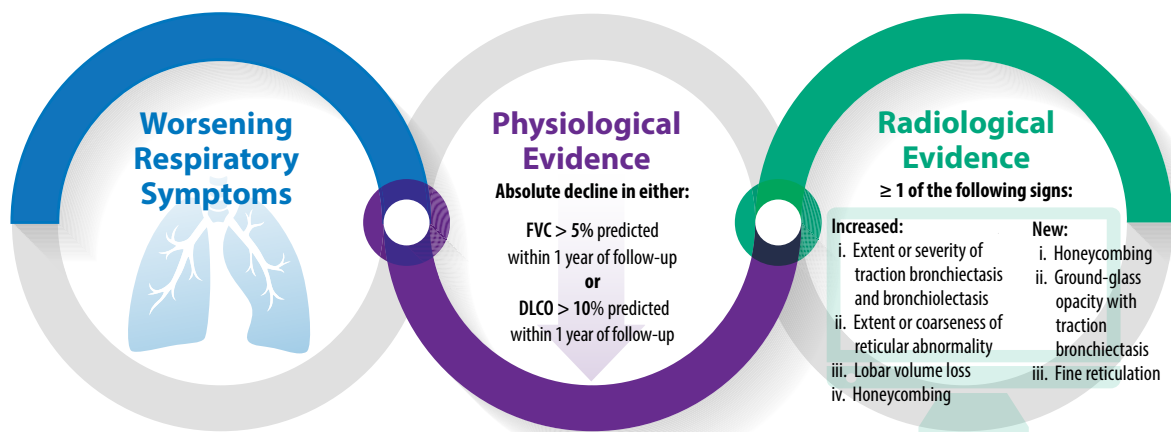
# Progressive Pulmonary Fibrosis: Understanding Its Many Forms

Tejaswini Kulkarni, MD, MPH, FCCP

The updated idiopathic pulmonary fibrosis guideline from the American Thoracic Society, European Respiratory Society, Japanese Respiratory Society, and Asociación Latinoamericana de Tórax was based on multiple clinical trials and includes many different disease manifestations. The intention of the update is to more accurately monitor disease progression to help inform therapeutic decisions for our patients.<sup>1</sup> Interstitial lung diseases (ILD) most likely to develop a progressive phenotype include idiopathic, nonspecific interstitial pneumonia; unclassifiable ILD; fibrotic hypersensitivity pneumonitis; and ILDs associated with autoimmune disorders.<sup>2</sup> Management of progressive pulmonary fibrosis (PPF) is far from a “one size fits all” approach. Many variables need to be better understood, such as how different disease etiologies progress, the role of comorbidities, and the best timing and sequence of therapy including escalation in immunosuppression and/or antifibrotic agents for different patient profiles.<sup>1,3</sup>

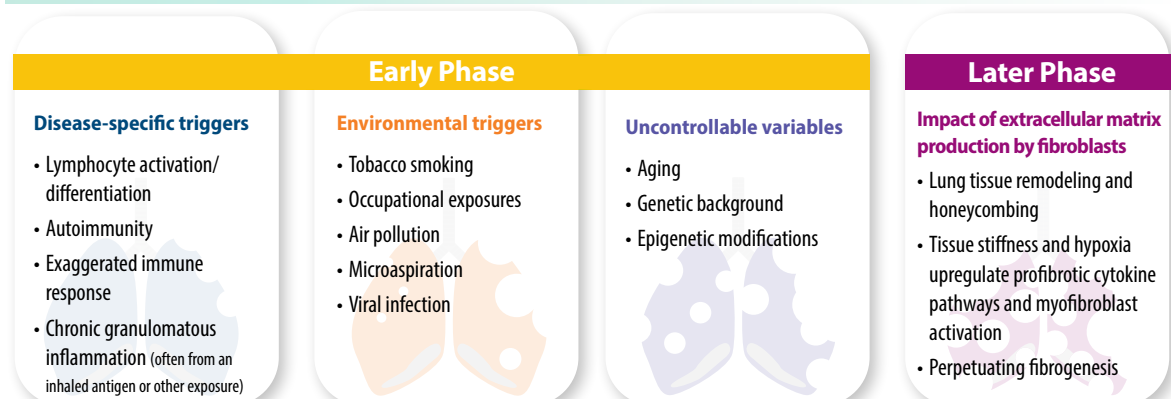
## New Definition for PPF<sup>1</sup>

In 2022, the American Thoracic Society established a new definition for PPF, formerly referred to as progressive fibrosing interstitial lung disease.<sup>1,4</sup> Patients with ILD with radiological evidence of pulmonary fibrosis meet the criteria for PPF if they have at least 2 of the following findings with no alternative known cause:



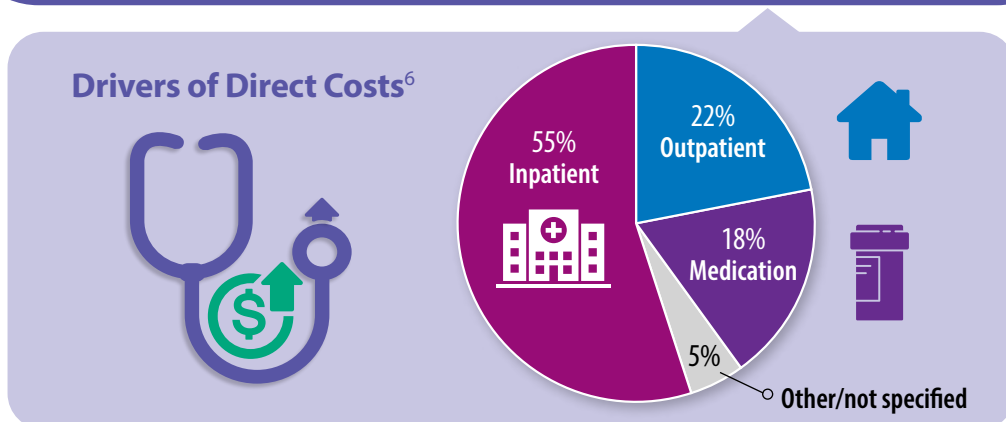
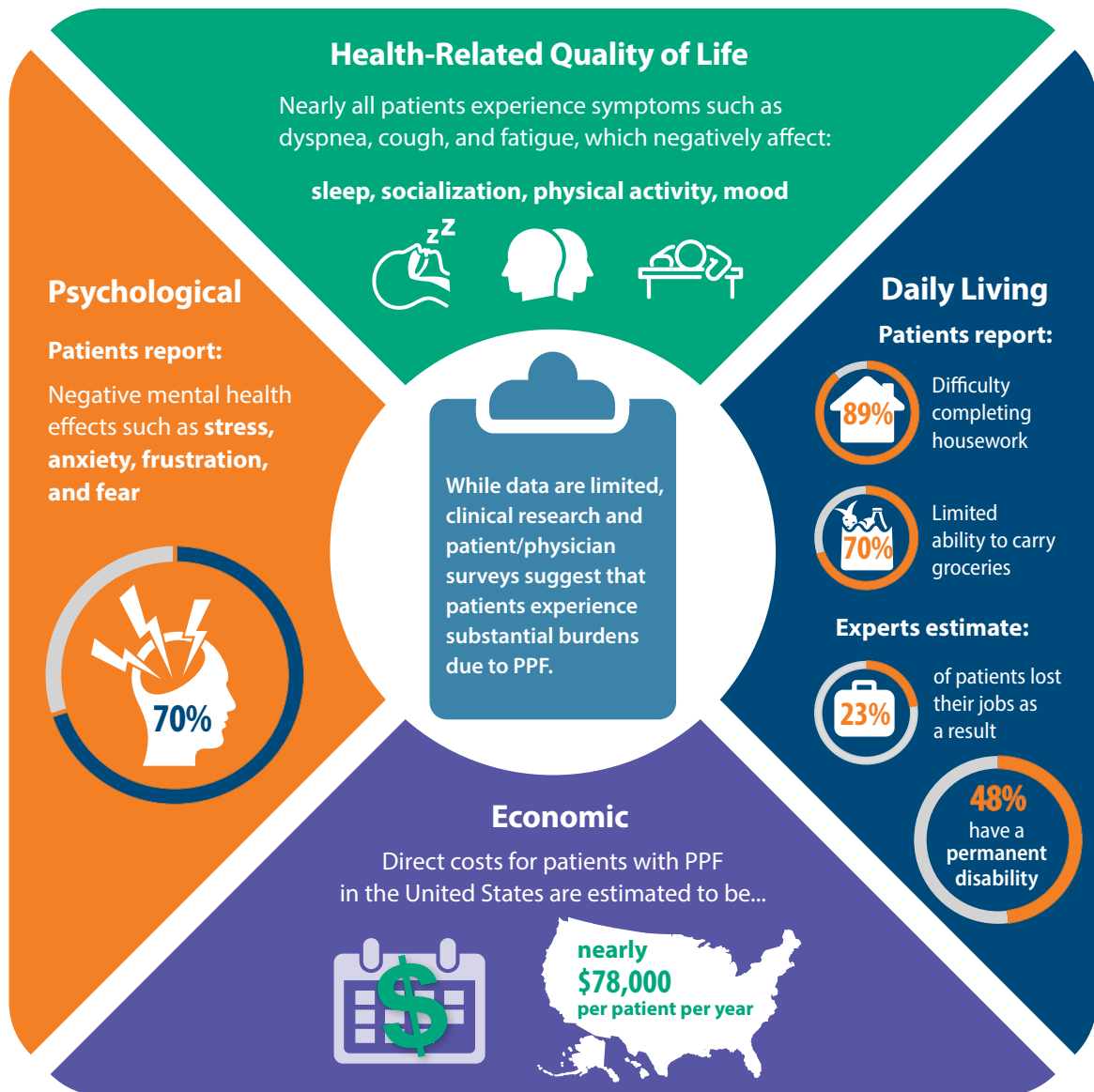
DLCO, diffusing capacity for carbon monoxide; FVC, forced vital capacity

## Pathophysiology of Pulmonary Fibrosis<sup>5</sup>





## Burdens of PPF<sup>2</sup>



In general, the overall prognosis and implication of PPF offer insight into early phase and later phase variables that are critical when defining the comprehensive burdens, which impact not only direct costs but also the specific approach clinicians take in treating this disease.

# Sleep Apnea: Comorbidities, Racial Disparities, Weight Guidelines, and Alternatives to CPAP


Lauren Tobias, MD, FCCP

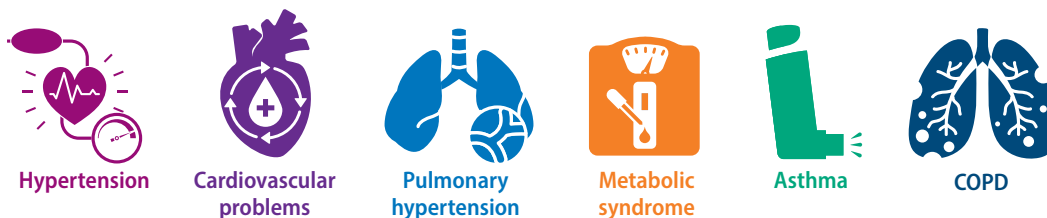
Obstructive sleep apnea (OSA) is a disorder in which the upper airway repeatedly collapses during sleep, resulting in hypoxemia and sleep disruption. Approximately 9-17% of women and 25-30% of men in the United States are diagnosed with OSA.<sup>1,2</sup> Patients may present with a range of symptoms, including daytime sleepiness, snoring, breathing pauses, or unexplained awakenings from sleep.<sup>1</sup> OSA severity is classified according to the apnea-hypopnea index (AHI), and defined by the presence of either  $\geq 15$  events per hour or 5-14 events per hour with symptoms such as excessive daytime sleepiness, insomnia, or impaired sleep-related quality of life.<sup>1</sup> OSA has been associated with stroke, hypertension, atrial fibrillation, coronary artery disease, heart failure, and mood disorders.<sup>3</sup> Continuous positive airway pressure (CPAP) is the standard of care for treating OSA in most patients and is highly cost-effective.<sup>4</sup>

Unfortunately, racial disparities exist in sleep apnea, as with sleep health generally. Black individuals have disproportionately high rates of OSA and higher OSA severity in comparison with White patients.<sup>5</sup> Racial inequity also exists in disease outcomes and sleep apnea-related mortality.<sup>5,6</sup> CPAP adherence may be lower in marginalized racial groups, with Black patients demonstrating lower nightly CPAP usage.<sup>4</sup> Initiatives are needed to improve sleep health equity, such as through increased access to sleep care through telehealth, lessening barriers to sleep apnea diagnostics, and reducing structural inequities associated with CPAP treatment including cost.

Obesity is a well-established risk factor for sleep apnea, and all patients whose body mass index (BMI) is elevated should be counseled on weight loss.<sup>7,8</sup> For patients unable to acclimate to CPAP, alternatives are available; there was increased reliance upon these during the recent major CPAP recall.<sup>9</sup> Some alternatives include mandibular advancement devices, positional therapy, and hypoglossal nerve stimulation therapy.<sup>9</sup> Emerging research is exploring the possibility of drug therapy to manage sleep apnea in the future.<sup>9</sup>

## Comorbidities in Sleep Apnea<sup>3,10</sup>

 80% of those diagnosed with OSA have comorbidities.



## Racial Disparities in Sleep Apnea-Related Mortality<sup>6</sup>

Age-adjusted mortality (per 1,000,000 population)



Black male patients' OSA-related mortality has increased by 2.7% from 1999-2019.<sup>6</sup>



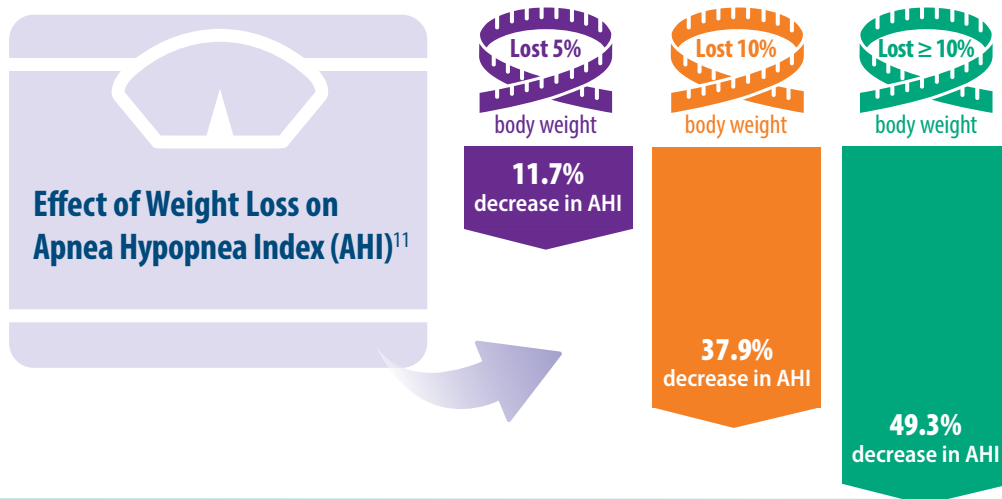
## ATS Clinical Practice Guidelines for Weight Management in Sleep Apnea<sup>7</sup>

Patients with **OSA who are overweight or obese** should be treated with lifestyle interventions, including:



For patients who need further assistance, anti-obesity **pharmacotherapy and/or bariatric surgery\*** should be considered.

\*Anti-obesity pharmacotherapy for BMI ≥ 27 and consider bariatric surgery referral for BMI ≥ 35.  
ATS, American Thoracic Society



## Alternative Treatments to CPAP<sup>9,11-16</sup>

Treatment	Description	Comments
<b>Behavioral modification</b>	Weight management, minimizing alcohol and sedatives before bedtime, and positional therapy (avoiding supine sleep)	Greater weight loss leads to more reduction in respiratory events; weight loss rarely leads to full resolution of OSA.
<b>Mandibular advancement device</b>	Plastic mouthpiece that moves the lower jaw forward, opening the airway	Candidates must have sufficient dentition in upper and lower jaws; the device is custom-fit by a dentist.
<b>Hypoglossal nerve stimulator</b>	Implantable device that stimulates the tongue to protrude in sync with a patient's respirations	Candidates must have BMI ≤ 32-35 and favorable soft palate collapse during sleep.
<b>Other upper airway surgeries</b>	Uvulopalatopharyngoplasty (UPPP) and variants that aim to reduce pharyngeal collapse and/or adenotonsillar enlargement	Patient selection is based on presence of a surgically correctable problem. Often guided by craniofacial imaging with a ~50% success rate.

**CPAP is the most effective treatment for OSA. Efficacy varies across studies, from ~20% to 80%.**

# Get Hands-on With CHEST Simulation Courses This November



## **From ICU to Home: Advances in Invasive and Noninvasive Ventilation**

**November 9 – 10**



Learn state-of-the-art techniques for managing home mechanical ventilators for patients with neuromuscular disease, obstructive lung disease, and chronic respiratory failure secondary to COVID-19.



## **Comprehensive Pleural Procedures With Cadavers**

**November 17**



Learn methods for managing patients with pleural disorders, including a step-by-step approach to ultrasound-guided thoracentesis, tunneled indwelling pleural catheter placement, and more.



## **Advanced Airway Management With Cadavers**

**November 18**



Practice basic and advanced ICU intubation skills for managing challenging airway scenarios. Build your competency with extraglottic airway insertion and cricothyrotomy methods via surgical and Seldinger techniques.

# Lung Cancer Screening: A Need for Adjunctive Testing

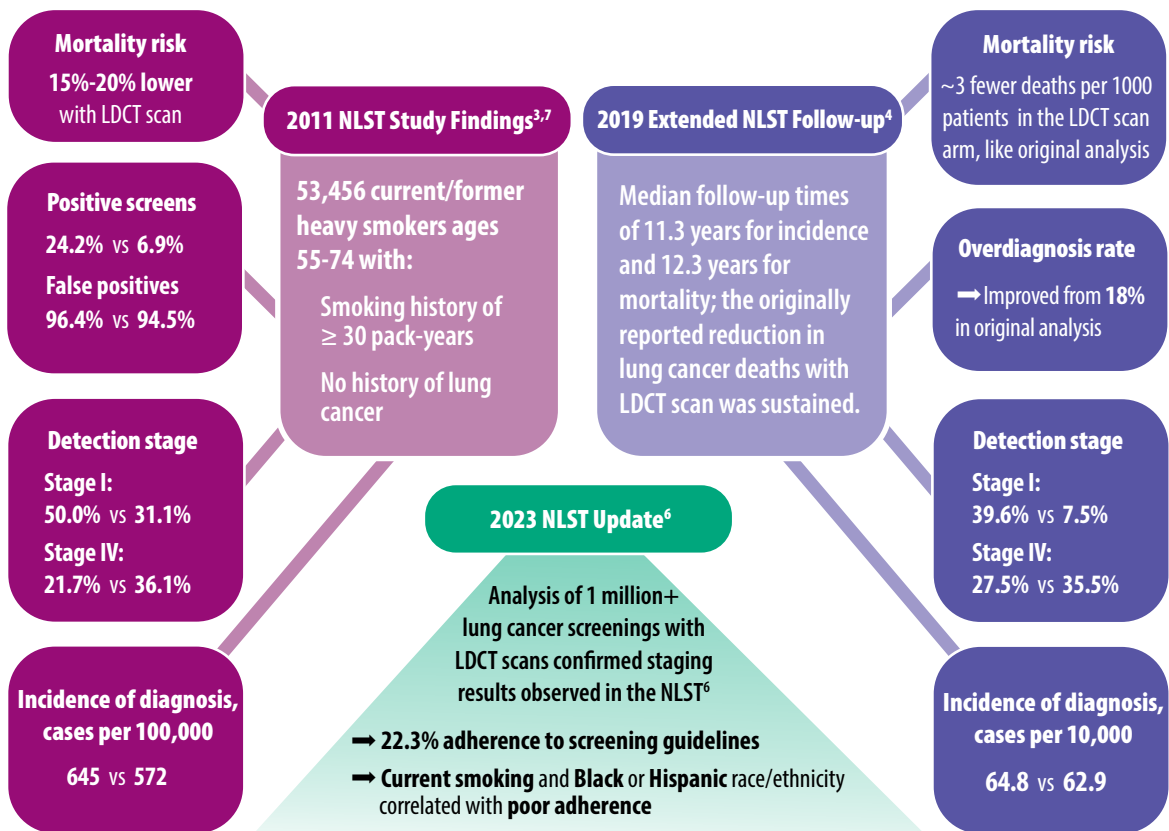
Eric S. Edell, MD, FCCP

Early detection of lung cancer by screening with low dose computed tomography (LDCT) scanning has long been investigated as a potential means of reducing related deaths.<sup>1,2</sup> The 2011 National Lung Screening Trial (NLST) compared LDCT scanning with standard chest radiograph (CXR). Results showed a significant reduction in mortality in high-risk current and former smokers who were screened annually (3×) with LDCT scan vs CXR.<sup>3</sup>

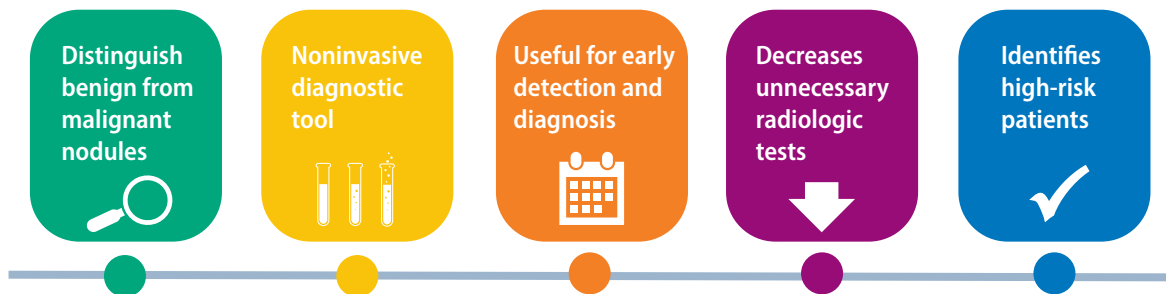
LDCT scanning for lung cancer is currently a standard of care, partially due to the results of the NLST.<sup>4,5</sup> In 2013, LDCT scanning was recommended by the US Preventive Services Task Force (USPSTF), making about 8 million Americans eligible for screening.<sup>6</sup> In 2019, an extended NLST cohort follow-up study showed that earlier detection with LDCT scanning not only delayed lung cancer death, but also prevented it—or at least delayed it by a decade or more.<sup>4,7</sup> This sparked another change in eligibility criteria in the 2021 USPSTF guidelines, allowing an additional 6.5 million people to be eligible for screening.<sup>6</sup>

Unfortunately, LDCT scanning has some negative aspects to its use, such as high false-positive rates, repeated radiation exposure, and the lack of ability to distinguish between nodules that are benign or malignant.<sup>8</sup> There is a need for adjunctive testing for screening. Some current research is focusing on the development of liquid biomarkers intended to be complementary to imaging as a method of using noninvasive lung cancer diagnostics.

## LDCT Scan vs CXR<sup>3,4,6,7</sup>



## Potential Benefits of Biomarkers for Detecting Lung Cancer<sup>8</sup>



## Review of Lung Cancer Biomarkers<sup>8</sup>








# Asthma Across a Woman's Lifespan

Navitha Ramesh, MD, FCCP

The severity and symptoms of asthma vary greatly across a woman's lifespan. Gender-based variances start early, with boys having a higher asthma prevalence than girls in childhood, and women having a higher prevalence than men starting around puberty and through adulthood, related to changes in sex hormones.<sup>1</sup> In the pediatric age group, questions arise about both the necessity and choice of biologic therapies and how best to transition patients from pediatric to adult care.<sup>2,3</sup> During this transition, patients often have worsening symptoms mainly due to decreased adherence to medications, lack of insurance, or lack of parental and social support.<sup>3</sup>

In adulthood, around 13% of women have asthma symptoms during pregnancy, necessitating maintenance treatment with inhalers.<sup>4</sup> In some women, asthma symptoms tend to worsen during pregnancy due to some of the natural changes in lung function and breathing patterns during pregnancy.<sup>4,5</sup> Uncontrolled asthma in pregnancy can lead to adverse effects for both mother and fetus. Maternal adverse outcomes include preeclampsia, placental abruption, increased risk of Caesarean sections, increased risk of gestational diabetes mellitus, and pulmonary embolism.<sup>4,6</sup> Child adverse outcomes include low birth weight, increased risk of minor congenital malformations, and asthma.<sup>4,5</sup> Aging in women also affects lung function, including reducing the forced expiratory volume in 1 second (FEV<sub>1</sub>).<sup>7</sup> Menopause specifically is related to decreased lung function due to changes in sex hormones, and this effect is seen even more in women with asthma.<sup>7,8</sup> It is important for providers to be aware of asthma manifestations throughout a woman's lifespan and personalize care accordingly.

## FDA-Approved Biologics for Pediatric Asthma<sup>2,9</sup>

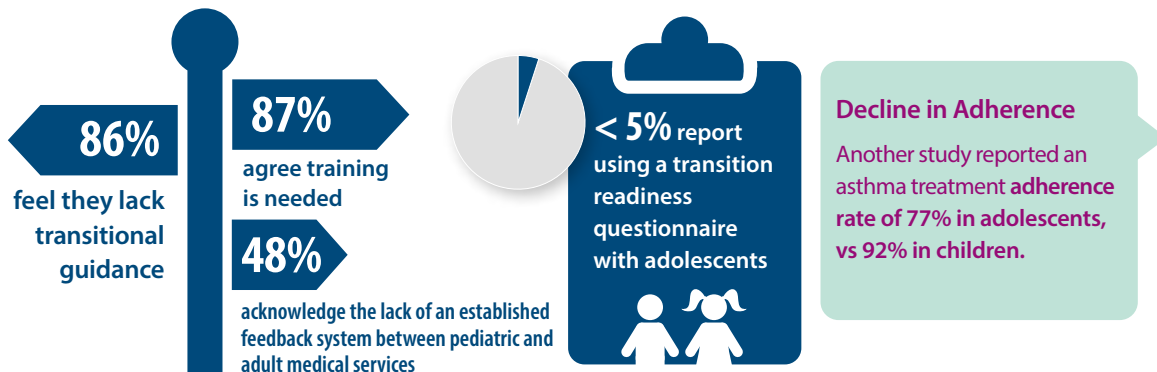
 Biologics	 Approved Age	 Mechanism
 Omalizumab	 6 years	Inhibits IgE, preventing activation of TH2
Mepolizumab	6 years	Binds to IL-5, reducing eosinophil levels
Benralizumab	12 years	Binds to IL-5, causing apoptosis of eosinophils
Dupilumab	6 years	Binds to IL-4, downregulating TH2 inflammatory pathways
Tezepelumab	12 years	Binds to TSLP, inhibiting upstream action in the inflammatory cascade

Ig, immunoglobulin; IL, interleukin; TH2, T helper 2; TSLP, thymic stromal lymphopoietin

As children grow, their lungs develop more alveoli and increase in capacity, which impacts asthma symptoms.<sup>10,11</sup> These changes, combined with the hormonal shifts associated with puberty, can worsen asthma symptoms in women.<sup>1</sup>

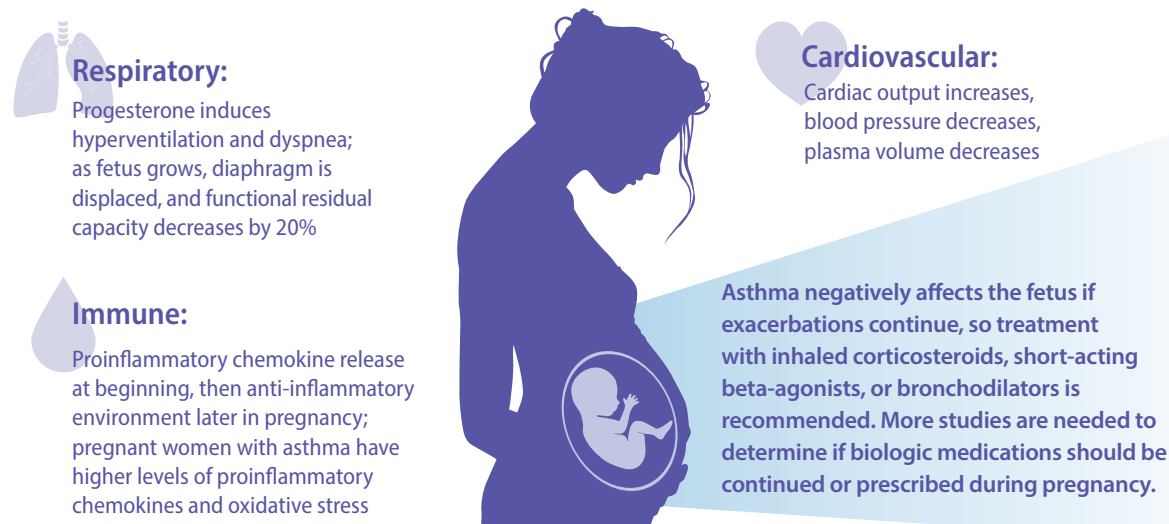
## Challenges in Transitioning from Pediatric to Adult Asthma Care<sup>3,12</sup>

A survey of HCPs treating adolescent and young adult patients with allergy and asthma revealed...

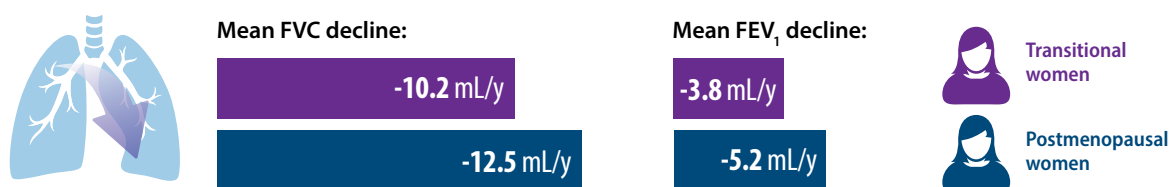


Pregnancy and menopause are also important times for asthma care during a woman's life, due to the physical changes that take place during these transitions.

## Effects of Asthma During Pregnancy<sup>5</sup>



## Airway Remodeling and Lung Function Decline During Menopause<sup>8,a</sup>



FEV<sub>1</sub>, forced expiratory volume in 1 second; FVC, forced vital capacity

<sup>a</sup>All data compared to regularly menstruating women.



# Introducing new open access journals to the journal *CHEST*<sup>®</sup> portfolio

*CHEST*<sup>®</sup> *Pulmonary* and *CHEST*<sup>®</sup> *Critical Care* editors are seeking high-quality submissions in all clinically relevant areas.

## Reasons to publish in *CHEST Pulmonary* and *CHEST Critical Care*

### QUALITY

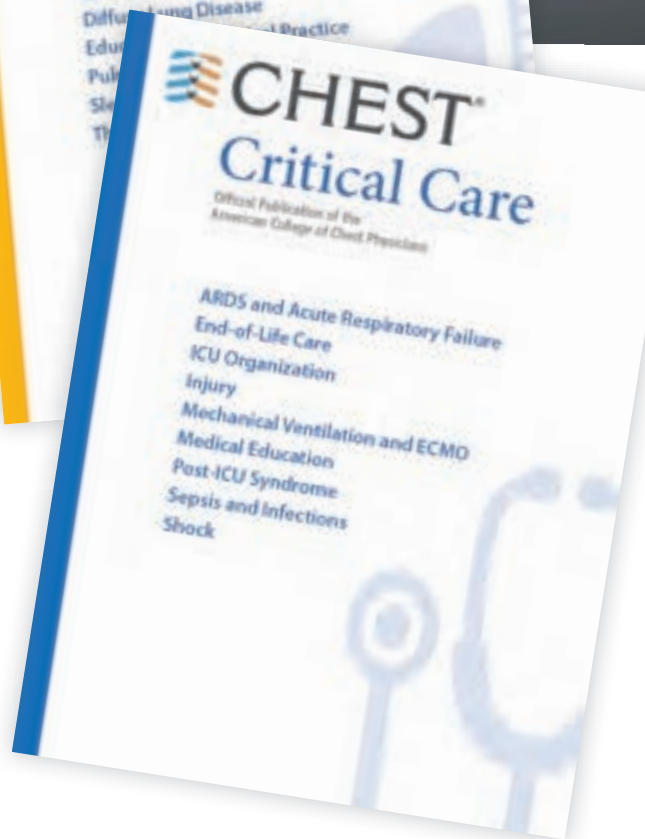
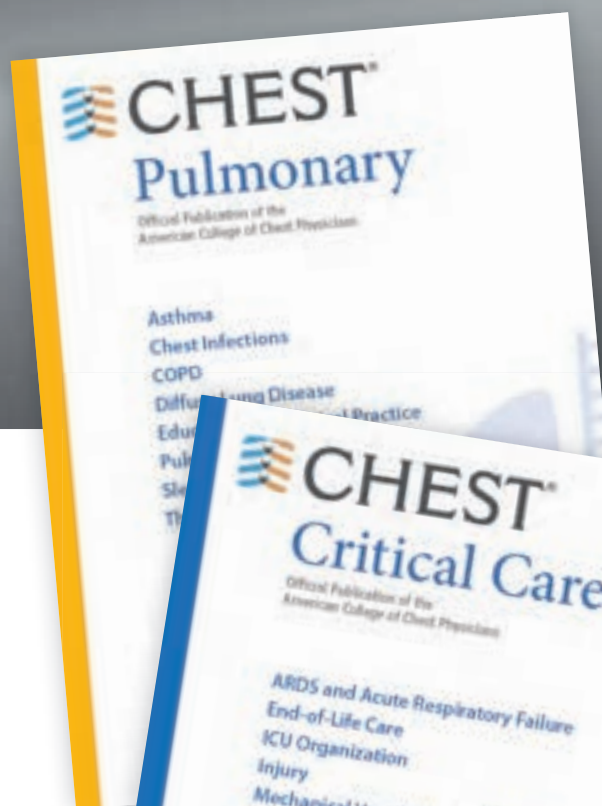
Brought to you in the same portfolio as the journal *CHEST*<sup>®</sup> (11.393 *Impact Factor*).

### HIGH USAGE AND VISIBILITY

Your article will be featured on multiple hosting platforms, including ScienceDirect, which has an audience of more than 1.5 million visitors daily.

### OPEN ACCESS

*CHEST Pulmonary* and *CHEST Critical Care* are peer-reviewed gold open access journals. Upon acceptance, your article will be available online within days, and it will be permanently and freely available online to read and share.



**Learn More  
& Submit**

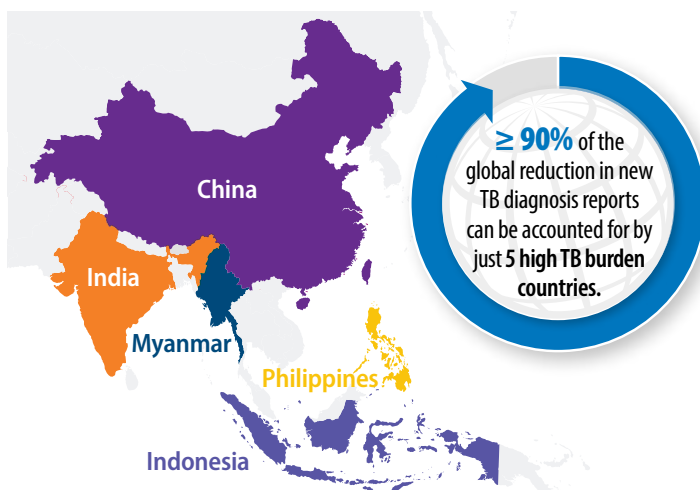
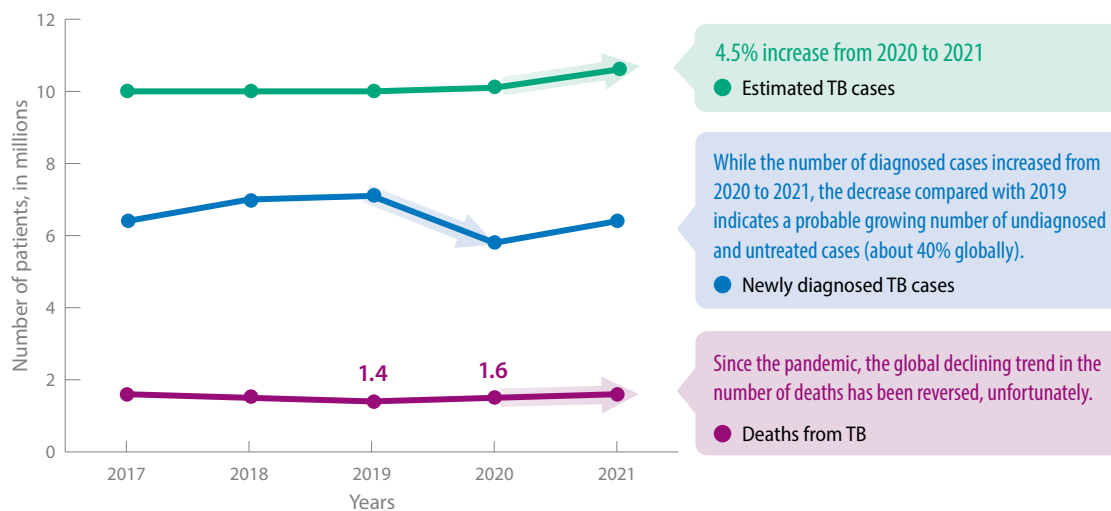
# Tuberculosis Management: Returning to Pre-Pandemic Priorities

Patricio Escalante, MD, MSc, FCCP, and Paige K. Marty, MD

Although we are officially living in a “post-pandemic” world, some long-term global impacts of COVID-19 are still being addressed. We remain off track on global tuberculosis (TB) milestone targets due to halted progress over the last 3 years, with more people going undiagnosed and untreated for TB compared with pre-pandemic years.<sup>1</sup> Drug-resistant TB (DR-TB) and multidrug-resistant TB (MDR-TB) continue to represent a major burden, and global spending on TB efforts remains significantly lower than what is needed to reach goals set forth by World Health Organization (WHO).<sup>1</sup>

Despite these challenges, there are also some exciting updates. We now know that TB treatment success rates remained steady during the pandemic (86%), and strong efforts have been made to address DR-TB and MDR-TB via improved treatment options with highly effective, all-oral, shortened treatment regimens, as well as new and promising testing modalities.<sup>1-3</sup>

## Global Burden of TB<sup>1</sup>



### Reasons for varying regional trends from 2019–2021 include:

- When each country was initially affected by the pandemic (including subsequent waves)
- Severity of COVID-19 impact
- Extent of local restrictions and adherence
- Local health care system capacity and resilience

## Tackling Drug-Resistant TB Globally<sup>1,3,4</sup>

Each year, about **500,000 new cases** of DR-TB or MDR-TB emerge, yet **only 1 in 3** of these patients **receive treatment**.<sup>1,3</sup>



This represents a **17% decrease** compared with pre-pandemic treatment rates.<sup>1</sup>



The number of patients with DR-TB or MDR-TB has increased by **20% annually** over the last decade.<sup>4</sup>

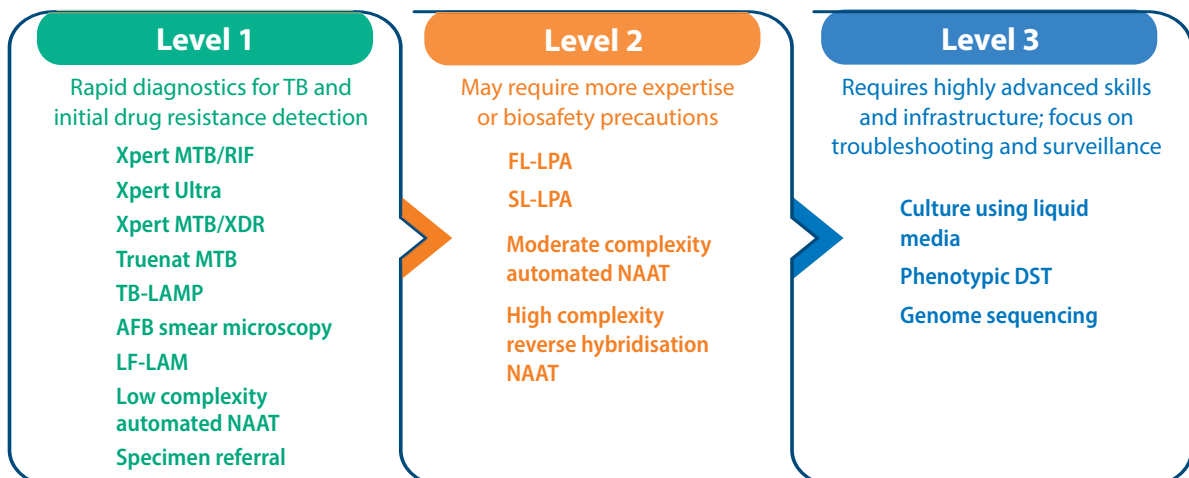
## Treatment of Drug-Resistant TB<sup>2,3,5-7</sup>

Regimen	Duration (months)	Evidence	Guidance
<b>BPaLM/BPaL</b>	<b>6</b>	~90% cure rate Patients are 2.2× more likely to experience favorable 24-month outcomes vs standard of care.	In 2023, WHO recommended accelerated implementation of this regimen due to its high efficacy and lower costs.
<b>All-oral, BDQ-based treatment for MDR-TB and XDR-TB</b>	<b>9</b>	Studies have shown success rates similar to 6-month BDQ regimens.	Use in patients with MDR/DR-TB without previous second-line treatment, FQ resistance, or extensive pulmonary or severe extrapulmonary TB disease.
<b>Individualized longer regimens</b>	<b>18+</b>	Varies based on drug grouping	Although new, shorter regimens are preferred, longer regimens are still necessary for patients with extensive forms of DR-TB or who are ineligible for shorter regimens.

BDQ, bedaquiline; BPaLM, bedaquiline, pretomanid, linezolid, moxifloxacin; FQ, fluoroquinolone; XDR, extensively drug-resistant.

## Notable Molecular Drug Resistance Testing Tools<sup>8,9</sup>

By laboratory network level



AFB, acid-fast bacilli; DST, drug susceptibility testing; FL, first-line; LAMP, loop-mediated isothermal amplification; LF-LAM, lateral flow lipoarabinomannan assay; LPA, line-probe assay; NAAT, nucleic acid amplification test; SL, second-line; TB, tuberculosis.

# Long COVID: Advocating for Patients and Implementing Effective Techniques

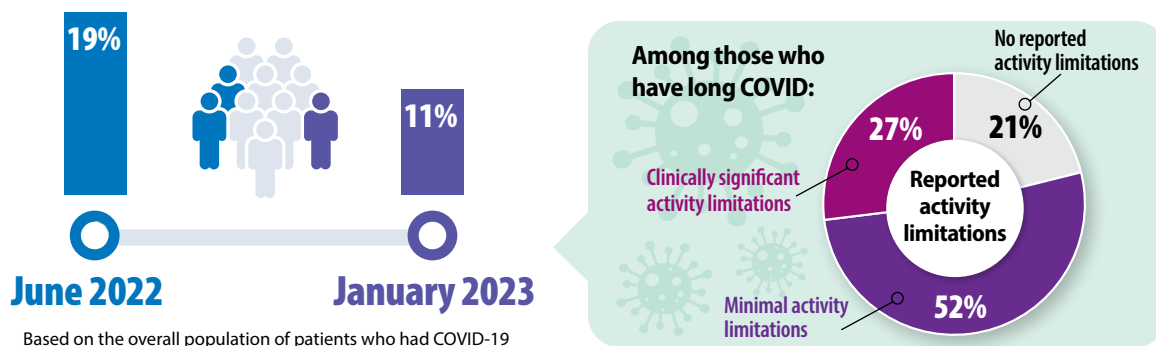
Kyle B. Enfield, MD, MS, FSHEA, FCCM

While definitions of postacute sequelae of SARS-CoV-2 (PASC), commonly referred to as long COVID, are heterogeneous, it is internationally recognized that some patients have symptoms that persist after recovery from their acute illness.<sup>1,2</sup> Most clinicians agree that this disease manifestation begins at around 60 to 90 days after original COVID-19 infection, based on the World Health Organization (WHO) definition.<sup>1</sup> Long COVID has similarities to postviral infections seen in SARS, MERS, Ebola, and West Nile virus.<sup>1,3</sup> Theories on its potential cause include ongoing inflammation and autoimmunity, among other theories.<sup>1,2</sup>





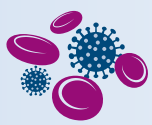
Currently, no FDA-approved treatments are available for long COVID and most patients are receiving variable care with off-label use of drugs.<sup>1</sup> Multiple clinical trials are in early stages. Certain nonpharmacological approaches have been effective for 2 common lingering long COVID symptoms: exercise intolerance and fatigue.<sup>4</sup> These techniques provide patients with tips to help manage decreased energy levels and provide breathing exercises for patients experiencing exercise intolerance.<sup>4</sup>

Long COVID is a challenge for the medical community, but progress is being made in pinpointing causes, effective treatments, and techniques to help people who continue to have symptoms after having had COVID-19.<sup>1,4</sup>

## Long COVID Prevalence in the United States<sup>5</sup>

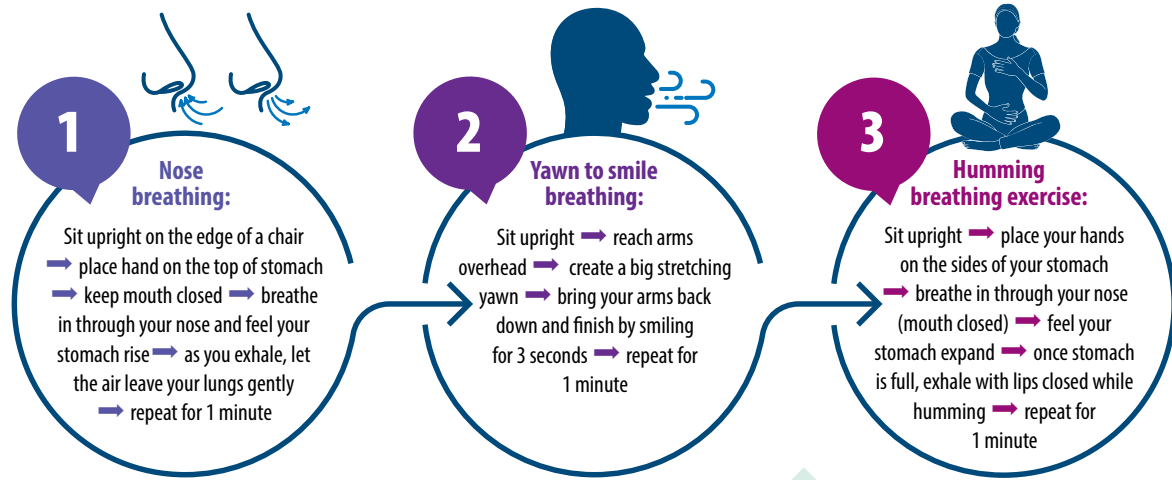


## Proposed Mechanism and Causes of Long COVID<sup>1,2,6,7</sup>

 <p><b>Immune dysregulation:</b> chronic stimulation of T cells and B cells from viral reservoir, persistence of pro-inflammatory cells, altered cytokine production, altered immunometabolism pathways</p>	 <p><b>Dysfunctional neurological signaling and neuroinflammation:</b> dysfunctional signaling in brainstem and vagus nerve, neuroinflammation and microglia activation, oxidative stress</p>
 <p><b>Microbiome dysbiosis:</b> SARS-CoV-2 adversely affects the microbiome, causing reduced microbial diversity</p>	 <p><b>Autoimmunity and immune priming:</b> molecular mimicry, autoimmune antibodies, microbial breakdown of tolerance</p>
 <p><b>Persistent endothelial injury:</b> microvascular blood clotting with endothelial injury</p>	

## Nonpharmacological Approaches for Long COVID Symptoms<sup>4</sup>

### Breathing Techniques for Exercise Intolerance and Fatigue



The UK's National Institute for Health and Care Excellence (NICE) recommends against a graded exercise program for people recovering from COVID-19. Graded exercise programs are structured exercise programs that gradually increase the amount of physical activity.

### Tips for Dealing with Fatigue



## Clinical Trials for Long COVID Treatments<sup>1,8,9</sup>

Treatments	Class of Drug	Clinical Trial Phase
Paxlovid	Protease inhibitor	Phase 2
Sodium pyruvate nasal spray	Pyruvic acid	Phase 2/3
Nirmatrelvir/ritonavir	Protease inhibitor	Phase 2
Prednisolone	Corticosteroids	N/A
Hyperbaric oxygen chamber	N/A	Phase 2
Naltrexone and NAD+	Opiate antagonist, and involved in glycolysis	Phase 2

The RECOVER Initiative is also working to collect data on long COVID to discover the long-term effects and improve current treatment options.<sup>9</sup> Learn more at [www.recovercovid.org](http://www.recovercovid.org).

Based on a ClinicalTrials.gov search of treatment: recruiting, active, not recruiting, completed, enrolling by invitation studies; Long+COVID. Results as of August 2, 2023.

N/A, not available; NAD+, nicotinamide adenine dinucleotide.

# References

## Long-Awaited RSV Vaccines Now Available for Older Adults and Pediatric Patients

- Jha A et al. Respiratory syncytial virus. In: Hui DS, Rossi GA, Johnston SL, eds. *Respiratory Syncytial Virus, SARS, MERS and Other Viral Lung Infections*. European Respiratory Society; 2016:chap 5. Accessed May 17, 2023.
- Ginsburg SA, Srikanth P. *Lancet Glob Health*. 2021;9(12):e1644-e6145. doi:10.1016/S2214-109X(21)00455-1
- US Food and Drug Administration. FDA approves first respiratory syncytial virus (RSV) vaccine [press release]. Published May 3, 2023. Accessed May 17, 2023. <https://www.fda.gov/news-events/press-announcements/fda-approves-first-respiratory-syncytial-virus-rsv-vaccine>
- US Food and Drug Administration. FDA Approves New Drug to Prevent RSV in Babies and Toddlers [press release]. Published July 17, 2023. Accessed August 11, 2023. <https://www.fda.gov/news-events/press-announcements/fda-approves-new-drug-prevent-rsv-babies-and-toddlers>
- US Food and Drug Administration. FDA Approves First Vaccine for Pregnant Individuals to Prevent RSV in Infants. Published August 21, 2023. Accessed August 22, 2023. <https://www.fda.gov/news-events/press-announcements/fda-approves-first-vaccine-pregnant-individuals-prevent-rsv-infants>
- Madhi SA et al. *N Engl J Med*. 2020;383(5):426-439. doi:10.1056/NEJMoa1908380
- Centers for Disease Control. Advisory Committee on Immunization Practices (ACIP) Meeting recommendations, August 2023. <https://www.cdc.gov/vaccines/acip/recommendations.html>Hammit LL, Dagan R, Yuan Y, et al.
- Hammit LL et al. *N Engl J Med*. 2022;386(9):837-846. doi:10.1056/NEJMoa2110275
- Centers for Disease Control and Prevention. RSV in infants and young children. Updated October 28, 2022. Accessed May 30, 2023. <https://www.cdc.gov/rsv/high-risk/infants-young-children.html>
- Centers for Disease Control and Prevention. RSV in older adults and adults with chronic medical conditions. Updated October 28, 2022. Accessed May 30, 2023. <https://www.cdc.gov/rsv/high-risk/older-adults.html>
- Widmer K et al. *J Infect Dis*. 2012;206(1):56-62. doi:10.1093/infdis/jis309
- Hall CB et al. *N Engl J Med*. 2009;360(6):588-598. doi:10.1056/NEJMoa0804877
- McLaughlin JM et al. *Open Forum Infect Dis*. 2022;9(7):ofac300. doi:10.1093/ofid/ofac300
- Thompson et al. *JAMA*. 2003;289(2):179-186. doi:10.1001/jama.289.2.179
- Hansen CL et al. *JAMA Netw Open*. 2022;5(2):e220527. doi:10.1001/jamanetworkopen.2022.0527
- Walsh EE et al; RENOIR Clinical Trial Group. *N Engl J Med*. 2023;388(16):1465-1477. doi:10.1056/NEJMoa2213836
- Martin JA et al. *Natl Vital Stat Rep*. 2019;68(13):1-47. PMID:32501202
- Townsi N et al. *Eur Clin Respir J*. 2018;5(1):1487214. doi:10.1080/20018525.2018.1487214
- Malek A et al. *Am J Reprod Immunol*. 1994;32(1):8-14. doi:10.1111/j.1600-0897.1994.tb00873.x
- Kampmann B et al; MATISSE Study Group. *N Engl J Med*. 2023;388(16):1451-1464. doi:10.1056/NEJMoa2216480
- Synagis (palivizumab) injection prescribing information. Published June 2023. Accessed August 2023. <https://www.synagis.com/synagis.pdf>
- Pulmonary embolism - thrombus removal with catheter-directed therapy (PE-TRACT). ClinicalTrials.gov. Updated July 17, 2023. Accessed July 18, 2023. <https://clinicaltrials.gov/ct2/show/NCT05591118>
- The PEERLESS study (PEERLESS). ClinicalTrials.gov. Updated Jun 23, 2023. Accessed July 18, 2023. <https://clinicaltrials.gov/ct2/show/NCT05111613>
- Inari Medical, Inc. Inari Medical announces Peerless II, a randomized controlled trial evaluating clinical outcomes of the FlowTriever<sup>®</sup> system vs. anticoagulation in pulmonary embolism patients [press release]. Published May 22, 2023. Accessed July 18, 2023. <https://ir.inarimedical.com/news-releases/news-release-details/inari-medical-announces-peerless-ii-randomized-controlled-trial>
- Ultrasound-facilitated, catheter-directed, thrombolysis in intermediate-high risk pulmonary embolism (HI-PEITHO). ClinicalTrials.gov. Updated July 17, 2023. Accessed July 18, 2023. <https://clinicaltrials.gov/ct2/show/NCT04790370>
- Comparison of two pulmonary embolism treatments. ClinicalTrials.gov. Updated May 31, 2023. Accessed July 18, 2023. <https://clinicaltrials.gov/ct2/show/NCT05684796>
- Pulmonary Embolism International Thrombolysis Study-3 (PEITHO-3). ClinicalTrials.gov. Updated June 8, 2023. Accessed July 18, 2023. <https://clinicaltrials.gov/ct2/show/NCT04430569>
- Study of the long-term safety and outcomes of treating pulmonary embolism with the Indigo Aspiration System. ClinicalTrials.gov. Updated May 11, 2023. Accessed July 18, 2023. <https://clinicaltrials.gov/ct2/show/NCT04798261>
- Bashir R et al. *J Am Coll Cardiol Interv*. 2022;15(23):2427-2436. doi:10.1016/j.jcin.2022.09.011

## Addressing Physician Burnout in Pulmonology and Critical Care

- Moss M et al. *Crit Care Med*. 2016;44(7):1414-1421. doi:10.1097/CCM.0000000000001885
- Medscape National Physician Burnout, Depression & Suicide Report 2019. Medscape. January 16, 2019. Accessed June 22, 2023. <https://www.medscape.com/slideshow/2019-lifestyle-burnout-depression-6011056#1>
- Medscape National Physician Burnout & Suicide Report 2020: The Generational Divide. Medscape. January 15, 2020. Accessed June 22, 2023. <https://www.medscape.com/slideshow/2020-lifestyle-burnout-6012460#1>
- 'Death by 1000 Cuts': Medscape National Physician Burnout & Suicide Report 2021. Medscape. January 22, 2021. Accessed June 22, 2023. <https://www.medscape.com/slideshow/2021-lifestyle-burnout-6013456#2>
- Physician Burnout Report 2022: Stress, Anxiety, and Anger. Medscape. January 21, 2022. Accessed June 22, 2023. <https://www.medscape.com/slideshow/2022-lifestyle-burnout-6014664#1>
- 'I Cry but No One Cares': Physician Burnout & Depression Report 2023. Medscape. January 27, 2023. Accessed June 22, 2023. <https://www.medscape.com/slideshow/2023-lifestyle-burnout-6016058#1>
- Murthy VH. *N Engl J Med*. 2022;387(7):577-579. doi:10.1056/NEJMp2207252
- Vranas KC et al. *Chest*. 2021;160(5):1714-1728. doi:10.1016/j.chest.2021.05.041
- Kerlin MP et al. *Ann Am Thorac Soc*. 2022;19(2):329-331. doi:10.1513/AnnalsATS.202105-567RL
- Dean W et al. *Fed Pract*. 2019;36(9):400-402. PMID:31571807
- Association of American Medical Colleges. The Complexities of Physician Supply and Demand: Projections from 2019 to 2034. June 2021. <https://www.aamc.org/media/54681/download?attachment>
- Medscape Pulmonologist Lifestyle, Happiness & Burnout Report 2023: Contentment Amid Stress. February 24, 2023. Accessed June 28, 2023. <https://www.medscape.com/slideshow/2023-lifestyle-pulmonologist-6016092#1>
- Medscape Intensivist Lifestyle, Happiness & Burnout Report 2023: Contentment Amid Stress. February 24, 2023. Accessed June 28, 2023. <https://www.medscape.com/slideshow/2023-lifestyle-intensivist-6016072#1>

## Updated Guidelines for COPD Management: 2023 GOLD Strategy Report

- Centers for Disease Control and Prevention. Data and statistics on venous thromboembolism. Last reviewed June 28, 2023. Accessed July 18, 2023. <https://www.cdc.gov/ncbddd/dvt/data.html>
- Becattini C et al. *Chest*. 2016;149(1):192-200. doi:10.1378/chest.15-0808
- Triantafyllou GA et al. *Semin Respir Crit Care Med*. 2021;42(2):183-198. doi:10.1055/s-0041-1722898
- Ng ACC et al. *Respiration*. 2013;85(5):408-416. doi:10.1159/000342024
- Phillips AR et al. *J Am Heart Assoc*. 2021;10(17):e021818. doi:10.1161/JAHA.121.021818
- Wadhera RK et al. *J Am Heart Assoc*. 2021;10(13):e021117. doi:10.1161/JAHA.121.021117
- Bashir R et al. *JACC Cardiovasc Interv*. 2022;15(23):2427-2436. doi:10.1016/j.jcin.2022.09.011
- Patel NJ et al. *Int J Cardiol*. 2019;287:116-117. doi:10.1016/j.ijcard.2019.04.029
- Li X et al. *Ann Transl Med*. 2021;9(10):838. doi:10.21037/atm-21-975
- Rivera-Lebron BN et al. *Chest*. 2021;159(1):347-355. doi:10.1016/j.chest.2020.07.065
- Noto JG, Rali P. *Pulm Circ*. 2022;12(1):e12021. doi:10.1002/pul2.12021
- Snyder DJ et al. *Vasc Med*. 2023;28(3):222-232. doi:10.1177/1358863X231157441
- Bikdeli B et al. *Semin Thromb Hemost*. 2023. doi:10.1055/s-0043-1764231
- Fleitas Sosa D et al. *Eur Respir Rev*. 2022;31(165):220023. doi:10.1183/16000617.0023-2022
- Global Initiative for Chronic Obstructive Lung Disease. Global Strategy for the Diagnosis, Management, and Prevention of Chronic Obstructive Pulmonary Disease (2023 Report). Published 2023. Accessed June 6, 2023. <https://goldcopd.org/2023-gold-report-2/>
- Celli B et al. *Am J Respir Crit Care Med*. 2022;206(11):1317. doi:10.1164/rccm.202204-0671PP
- Han M et al. *Lancet Respir Med*. 2013;1(1):43-50. doi:10.1016/S2213-2600(12)70044-9
- Klijn SL et al. *NPJ Prim Care Respir Med*. 2017;27(1):24. doi:10.1038/s41533-017-0022-1
- Chan AH et al. *J Allergy Clin Immunol Pract*. 2015;3(3):335-349.e1-e5. doi:10.1016/j.jaip.2015.01.024
- Brusselle G et al. *Int J Chron Obstruct Pulmon Dis*. 2015;10:2207-2217. doi:10.2147/COPD.S91694

- Salvi SS, Barnes PJ. *Lancet*. 2009;374(9691):733-743. doi:10.1016/S0140-6736(09)61303-9
- Trupin L et al. *Eur Respir J*. 2003;22(3):462-469. doi:10.1183/09031936.03.00094203
- Celli BR et al. *Am J Respir Crit Care Med*. 2021;204(11):1251-1258. doi:10.1164/rccm.202108-1819PP
- Barnes PJ, Celli BR. *Eur Respir J*. 2009;33(5):1165-1185. doi:10.1183/09031936.00128008

### Progressive Pulmonary Fibrosis: Understanding Its Many Forms

- Raghu G et al. *Am J Respir Crit Care Med*. 2022;205(9):e18-e47. doi:10.1164/rccm.202202-0399ST
- Cottin V et al. *Front Med (Lausanne)*. 2022;9:799912. doi:10.3389/fmed.2022.799912
- Molina-Molina M et al. *Expert Rev Respir Med*. 2022;16(7):765-774. doi:10.1080/17476348.2022.2107508
- Cottin V. *Am J Respir Crit Care Med*. 2023;207(1):11-13. doi:10.1164/rccm.202208-1639ED
- Wijsenbeek M, Cottin V. *N Engl J Med*. 2020;383(10):958-968. doi:10.1056/NEJMra2005230
- Wong AW et al. *BMC Pulm Med*. 2022;22(1):148. doi:10.1186/s12890-022-01922-2

### Sleep Apnea: Comorbidities, Racial Disparities, Weight Guidelines, and Alternatives to CPAP

- Gottlieb DJ, Punjabi NM. *JAMA*. 2020;323(14):1389-1400. doi:10.1001/jama.2020.3514
- Slowik JM et al. Obstructive Sleep Apnea. In: *StatPearls*. Treasure Island (FL): StatPearls Publishing; December 11, 2022.
- Bonignore MR et al. *Multidiscip Respir Med*. 2019;14:8. doi:10.1186/s40248-019-0172-9
- Schwartz SW et al. *Sleep Breath*. 2016;20(3):947-955. doi:10.1007/s11325-016-1316-1
- Grandner MA et al. *Sleep Med*. 2016;18:7-18. doi:10.1016/j.sleep.2015.01.020
- Lee YC et al. *Sleep Med*. 2022;90:204-213. doi:10.1016/j.sleep.2021.11.014
- Hudgel DW et al. *Am J Respir Crit Care Med*. 2018;198(6):e70-e87. doi:10.1164/rccm.201807-1326ST
- Lloyd R et al. *J Clin Sleep Med*. 2022;18(11):2673-2680. doi:10.5664/jcsm.10244
- Nokes B et al. *Expert Rev Respir Med*. 2022;16(8):917-929. doi:10.1080/1747634.8.2022.2112669
- Pinto JA et al. *Int Arch Otorhinolaryngol*. 2016;20(2):145-150. doi:10.1055/s-0036-1579546
- Georgoulis M et al. *J Clin Sleep Med*. 2022;18(5):1251-1261. doi:10.5664/jcsm.9834
- Askland K et al. *Cochrane Database Syst Rev*. 2020;4(4):CD007736. doi:10.1002/14651858.CD007736.pub3
- Jugé L et al. *Sleep*. 2022;45(6):zsac044. doi:10.1093/sleep/zsac044
- Strollo PJ Jr et al. *N Engl J Med*. 2014;370(2):139-149. doi:10.1056/NEJMoa1308659
- Fattal D et al. *J Clin Sleep Med*. 2022;18(12):2723-2729. doi:10.5664/jcsm.10190
- He M et al. *Otolaryngol Head Neck Surg*. 2019;161(3):401-411. doi:10.1177/0194599819840356

### Lung Cancer Screening: A Need for Adjunctive Testing

- Naidich DP et al. *Radiology*. 1990;175(3):729-731. doi:10.1148/radiology.175.3.2343122
- Kaneko M et al. *Radiology*. 1996;201(3):798-802. doi:10.1148/radiology.201.3.8939234
- National Lung Screening Trial Research Team. *Radiology*. 2011;258(1):243-253. doi:10.1148/radiol.10091808
- National Lung Screening Trial Research Team. *J Thorac Oncol*. 2019;14(10):1732-1742. doi:10.1016/j.jtho.2019.05.044
- Mazzone PJ et al. *Chest*. 2021;160(5):e427-e494. doi:10.1016/j.chest.2021.06.063
- Tanner NT et al. *Chest*. 2023;S0012-3692(23)00175-7. doi:10.1016/j.chest.2023.02.003
- National Lung Screening Trial Research Team. *N Engl J Med*. 2011;365(5):395-409. doi:10.1056/NEJMoa1102873
- Marmor HN et al. *Curr Chall Thorac Surg*. 2023;5:5. doi:10.21037/cts-20-171

### Asthma Across a Woman's Lifespan

- Chowdhury NU et al. *Eur Respir Rev*. 2021;30(162):210067. doi:10.1183/16000617.0067-2021

- Perikleous EP et al. *J Pers Med*. 2022;12(6):999. doi:10.3390/jpm12060999
- Khaleva E et al. *Clin Transl Allergy*. 2020;10:40. doi:10.1186/s13601-020-00340-z
- Robijn AL et al. *Curr Opin Pulm Med*. 2019;25(1):11-17. doi:10.1097/MCP.0000000000000538
- Bravo-Solarte DC et al. *Allergy Asthma Proc*. 2023;44(1):24-34. doi:10.2500/aap.2023.44.220077
- Wang G et al. *J Matern Fetal Neonatal Med*. 2014;27(9):934-942. doi:10.3109/14767058.2013.847080
- Hough KP et al. *Front Med (Lausanne)*. 2020;7:191. doi:10.3389/fmed.2020.00191
- Triebner K et al. *Am J Respir Crit Care Med*. 2017;195(8):1058-1065. doi:10.1164/rccm.201605-0968OC
- Bacharier LB, Jackson DJ. *J Allergy Clin Immunol*. 2023;151(3):581-589. doi:10.1016/j.jaci.2023.01.002
- An amazing journey: how young lungs develop. American Lung Association. Published May 11, 2018. Accessed June 28, 2023. <https://www.lung.org/blog/how-young-lungs-develop>
- Strunk RC et al. *J Allergy Clin Immunol*. 2006;118(5):1040-1047. doi:10.1016/j.jaci.2006.07.053
- Kaplan A, Price D. *J Asthma Allergy*. 2020;13:39-49. doi:10.2147/JAA.S233268

### Tuberculosis Management: Returning to Pre-Pandemic Priorities

- Global tuberculosis report 2022. World Health Organization. Published October 27, 2022. Accessed June 26, 2023. <https://www.who.int/publications/i/item/9789240061729>
- WHO consolidated guidelines on tuberculosis. Module 4: treatment – drug-resistant tuberculosis treatment, 2022 update. World Health Organization. Published December 15, 2022. Accessed June 26, 2023. <https://www.who.int/publications/i/item/9789240063129>
- Migliori GB, Tiberi S. *Int J Tuberc Lung Dis*. 2022;26(7):590-591. doi:10.5588/ijtld.22.0263.
- Lange C et al. *Am J Respir Crit Care Med*. 2022;205(10):1142-1144. doi:10.1164/rccm.202202-0393ED
- Esmail A et al. *Am J Respir Crit Care Med*. 2022;205(10):1214-1227. doi:10.1164/rccm.202107-1779OC
- WHO BPaLM Accelerator Platform: to support the call to action for implementation of the shorter and more effective treatment for all people suffering from drug-resistant TB. World Health Organization. Published May 9, 2023. Accessed June 26, 2023. <https://www.who.int/news-room/events/detail/2023/05/09/default-calendar/who-bpalm-accelerator-platform-to-support-the-call-to-action-for-implementation-of-the-shorter-and-more-effective-treatment-for-all-people-suffering-from-drug-resistant-tb>
- Trevisi L et al. *Am J Respir Crit Care Med*. 2023;207(11):1525-1532. doi:10.1164/rccm.202211-2125OC
- Dominguez J et al; TBnet and RESIST-TB networks. *Lancet Infect Dis*. 2023;23(4):e122-e137. doi:10.1016/S1473-3099(22)00875-1
- WHO operational handbook on tuberculosis: module 3: diagnosis: rapid diagnostics for tuberculosis detection, 2021 update. World Health Organization. Published July 7, 2021. Accessed June 26, 2023. <https://www.who.int/publications/i/item/9789240030589>

### Long COVID: Advocating for Patients and Implementing Effective Techniques

- Lutchmansingh DD et al. *Semin Respir Crit Care Med*. 2023;44(1):130-142. doi:10.1055/s-0042-1759568
- Davis HE et al. *Nat Rev Microbiol*. 2023;21(3):133-146. doi:10.1038/s41579-022-00846-2
- Ahmed H et al. *J Rehabil Med*. 2020;52(5):jrm00063. doi:10.2340/16501977-2694
- Resources. Long COVID Physio. Accessed May 31, 2023. <https://longcovid.physio/resources>
- Long COVID: What do the latest data show? KFF. Published January 26, 2023. Accessed May 31, 2023. <https://www.kff.org/policy-watch/long-covid-what-do-latest-data-show/>
- Castanares-Zapatero D et al. *Ann Med*. 2022;54(1):1473-1487. doi:10.1080/07853890.2022.2076901
- Mehandru S, Merad M. *Nat Immunol*. 2022;23(2):194-202. doi:10.1038/s41590-021-01104-y
- Dhooria S et al. *Eur Respir J*. 2022;59(2):2102930. doi:10.1183/13993003.02930-2021
- Researching COVID to enhance recovery. RECOVER. Accessed May 31, 2023. <https://recovercovid.org/>

Patients with benign nodules managed with the **Nodify XL2<sup>®</sup>** test were

**74%** less likely

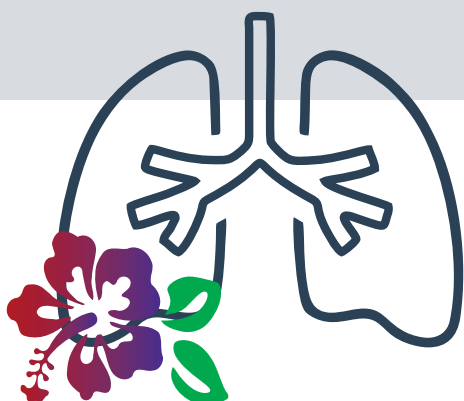
**to undergo an unnecessary invasive procedure** compared to the control group in a prospective, real-world clinical utility registry study.\*



\*Pritchett et al. *PLoS One*. 2023. 18(7) 10.1371/journal.pone.0287409

Come see us in Honolulu for CHEST 2023!

**Booth #1831**



Stop by to learn about  
**Nodify Lung<sup>®</sup> Nodule  
Risk Assessment Testing**  
to reclassify risk of malignancy.

Scan the QR code to find out about the presentations and events Biodesix will be hosting at the 2023 CHEST Annual Meeting.

